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For related information see also *Astronautics.*

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For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 384
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 384
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 385
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 386
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 387

89 ASTRONOMY 387
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 387
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 389
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 389
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 390
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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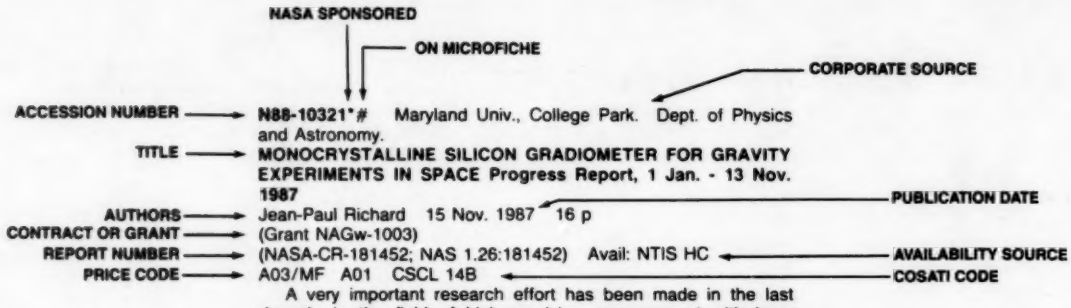
TYPICAL CITATION AND ABSTRACT



A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N88-11628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOVIET AVIATION TECHNOLOGY'S STATE OF THE ART SU-27 FIGHTER
Gong Fei 15 Jul. 1987 12 p Transl. into ENGLISH from Conmilit (People's Republic of China), v. 1, issue 122, 1 Jan. 1987 p 61-62
(AD-A184121; FTD-ID(RS)T-0528-87) Avail: NTIS HC A03/MF A01 CSCL 01C

The SU-27 fighter makes use of avionics equipment representing the highest current level of Soviet technology and is estimated to be comparable in its overall capabilities to third generation U.S. fighters. What is attracting peoples' interest is whether or not the SU-27 is able to undertake long range interceptor missions or has been created as a medium-type fighter for loading aboard aircraft carriers. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-11629# Naval Postgraduate School, Monterey, Calif.
A HEAT TRANSFER MODEL FOR A HEATED HELIUM AIRSHIP M.S. Thesis
Ray M. Rapert Mar. 1987 85 p
(AD-A183786) Avail: NTIS HC A05/MF A01 CSCL 01A

Basic heat transfer empirical and analytical equations are applied to a double envelope airship concept which uses heated helium in the inner envelope to augment and/or control gross lift. The convective and conductive terms lead to a linear system of five equations for the concept airship, with the nonlinear radiation terms included by an iterative solution process. A FORTRAN program, is used to perform the tedious calculations, and graphed results are obtained for the variables of interest. These indicate that the simple use of airship engine exhaust heat will give more than a 30 percent increase in gross airship lift. Possibly more than 100 percent increase can be achieved if a steam injection heating system, with associated design problems, is used. GRA

N88-11630# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
CONTROL AND STABILIZATION MECHANISMS OF SUBMUNITIONS [STEUER- UND STABILISIERUNGSMIECHANISMEN VON SUBMUNITIONEN]
Karl-Fnedrich Doherr, Dieter Muenscher, and Christos Saliaris Feb. 1986 61 p In GERMAN
(DFVLR-IB-111-86/9; ETN-87-90564) Avail: NTIS HC A04/MF A01

The possibilities of deceleration, stabilization, control, and rotation of submunitions by aerodynamic deceleration systems such as parachutes, rotating parachutes, or ballutes are surveyed. The criteria for the design of intelligent submunitions are discussed. Drag, reefing, and stability or nonrotating parachutes are treated. Rotor quality number, and transferable rolling moment of rotating parachutes are discussed. ESA

N88-11631# European Space Agency, Paris (France).
A SUPERSONIC POTENTIAL GRADIENT METHOD FOR THE CALCULATION OF UNSTEADY AERODYNAMIC PRESSURES ON HARMONICALLY OSCILLATING WINGS
Fuqing Zhang Sep. 1987 117 p Transl. into ENGLISH of Ein Supersonisches Potentialgradienten-Verfahren zur Berechnung der Instationaeren Luftkraefte Harmonisch Schwingender Traegflaechen (Goettingen, Federal Republic of Germany) Original language document was announced as N85-31026
(ESA-TT-930; DFVLR-FB-86-11; ETN-87-91109) Avail: NTIS HC A06/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany

A method for calculating unsteady aerodynamic pressure distribution on harmonically oscillating three-dimensional wings in supersonic flow based on the velocity potential, the Jones-Appa gradient method, and on the application of an integral variable substitution to evaluate the aerodynamic influence function was developed. The method simplifies the computation and reduces computing time at low supersonic Mach numbers and high reduced frequencies. Investigations on typical wing configurations confirm accuracy. ESA

N88-11632# European Space Agency, Paris (France).
A CALCULATION METHOD FOR THE PROPULSIVE JET AND ITS AERODYNAMIC INTERACTION WITH AN AFTERBODY
Rolf Radespiel Apr. 1987 137 p Transl. into ENGLISH of Ein Berechnungsverfahren fuer den Triebwerksstrahl und dessen Aerodynamische Wechselwirkung mit einem Heckkoerper (Brunswick, Federal Republic of Germany) Original language document was previously announced as N87-14292
(ESA-TT-1039; DFVLR-FB-86-29; ETN-87-91117) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 37

A calculation method for single and multistream jet flows and their aerodynamic interaction with an afterbody is developed. The governing equations of viscous and inviscid flow fields are given in natural coordinates of the viscous flow. A transpiration mode takes into account the viscous inviscid interactions. Reynolds stresses and turbulent heat fluxes are calculated using kinetic energy, dissipation rate, and intermittency factor of turbulence. The calculation method is first applied on classical boundary layer flows, then verified by calculations of flows around afterbodies with single and two stream jets. ESA

N88-11633# European Space Agency, Paris (France).
ON THE PREDICTION OF THE AEROELASTIC BEHAVIOR OF LIFTING SYSTEMS DUE TO FLOW SEPARATION
Hartmut Zingel Sep. 1987 166 p Transl. into ENGLISH of Zur Bestimmung des Aeroelastischen Verhaltens von Auftriebssystemen Infolge von Stroemungsabloesung (Goettingen, Federal Republic of Germany) Original language document was previously announced as N87-17685
(ESA-TT-1043; DFVLR-FB-86-35; ETN-87-91118) Avail: NTIS HC A08/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 51.50

The prediction of structural vibrations on the basis of linear equations of motion is described for the case of a trapezoidal wing model. The unsteady aerodynamic quantities are determined in wind tunnel experiments. The dynamic response behavior at separated flow measured on a freely vibrating model in a wind tunnel was approximated by a calculated prediction. For coupled vibrations, simplified equations of motion can be used. ESA

N88-11634# European Space Agency, Paris (France).
INVESTIGATIONS ON A TRANSONIC AIRFOIL WITH A 30 mm WIDE PERFORATION/CAVITY ARRANGEMENT
Paul Krogmann Sep. 1987 49 p Transl. into ENGLISH of Untersuchungen an einem Transsonischen Profil mit 30 mm Breiter Perforation/Kammer-Anordnung (Goettingen, Fed. Republic of Germany, DFVLR), Nov. 1986 Original language document was announced as N87-28506
(ESA-TT-1072; DFVLR-FB-86-59; ETN-87-91131) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 16

Pressure distribution and wake measurements were carried out in a 1m x 1m transonic wind tunnel on a two-dimensional supercritical airfoil equipped with a perforated strip and a cavity underneath. Compared with reference measurements on the same model with a solid surface, the results of the model with the perforation/cavity arrangement at supercritical flow conditions show a substantial increase of the maximum lift and especially strong drag reductions. These aerodynamic improvements are related to the very favorable effect of the passive secondary flow through the perforation and cavity, induced by strong adverse pressure gradients in this region. The detrimental effects of the passive device on the aerodynamic characteristics of the airfoil at subcritical flow are negligible. ESA

N88-11635# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Physics.
THE PHYSICS AND MATHEMATICAL DESCRIPTION OF THE ACHILLES HEEL OF STATIONARY WIND TURBINE AERODYNAMICS: THE TIP FLOW
G. A. M. vanKuik Oct. 1986 9 p Presented at the 6th European Wind Energy Conference, Rome, Italy, Oct. 1986
(R-812-D; ETN-87-91311) Avail: NTIS HC A02/MF A01

By comparison of wing theory with rotor theory the significant influence of the blade tip load and tip vortex on the nonlinear flow behavior is shown. The ideal actuator disk carries a discrete force at the edge, having an axial and radial component. In all other situations this edge force appears as a distributed force along the blade, with a concentration near the tip. The radial forces increase the mass flow as in augmented systems, while the axial edge forces restore the momentum balance. The radial forces at the rotor blades are physically realized by viscous stresses in the boundary layer. Due to the strong flow asymmetry with respect to the blade, these radial forces are much more significant than in ordinary wing theory. This might be the explanation of the remarkable changes in airfoil characteristics due to radial effects. ESA

N88-11636*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A CRITICAL ASSESSMENT OF WIND TUNNEL RESULTS FOR THE NACA 0012 AIRFOIL
W. J. McCroskey Oct. 1987 24 p Presented at the AGARD Fluid Dynamics Panel Symposium on Aerodynamic Data Accuracy and Quality: Requirements and Capabilities in Wind Tunnel Testing, Naples, Italy, 28 Sep. - 2 Oct. 1987
(NASA-TM-100019; A-87321; NAS 1.15:100019; USAAVSCOM-TM-87-A-5) Avail: NTIS HC A03/MF A01 CSCL 01A

A large body of experimental results, obtained in more than 40 wind tunnels on a single, well-known two-dimensional configuration, has been critically examined and correlated. An assessment of some of the possible sources of error has been made for each facility, and data which are suspect have been identified. It was found that no single experiment provided a complete set of reliable data, although one investigation stands out as superior in many respects. However, from the aggregate of data the representative properties of the NACA 0012 airfoil can be identified with reasonable confidence over wide ranges of Mach number, Reynolds number, and angles of attack. This synthesized information can now be used to assess and validate existing and future wind tunnel results and to evaluate advanced Computational Fluid Dynamics codes. Author

N88-11637 Iowa State Univ. of Science and Technology, Ames.
EFFICIENT NUMERICAL APPROACHES FOR PREDICTING SUPERSONIC FLOWS WITH VISCOUS/INVISCID INTERACTION Ph.D. Thesis
David Seitz Thompson 1987 190 p
Avail: Univ. Microfilms Order No. DA8716829

Three different approaches for efficiently computing supersonic flow fields with strong viscous/inviscid interaction were critically examined. First, the single-pass philosophy employed for the solution of the parabolized Navier-Stokes (PNS) equations was considered. Based on comparisons with other computed results, the single-pass philosophy is inadequate purely from the standpoint that it suppresses the streamwise elliptic behavior present in the solution. A second-order global pressure iteration (GPI) algorithm was developed using the Vigeron splitting to determine the portion of the streamwise pressure gradient that is responsible for streamwise elliptic behavior. Results predicted using the GPI algorithm show good agreement with results presented in literature. In addition to the GPI algorithm, a second-order algorithm was developed using a hybrid approach. Results predicted using the hybrid algorithm were very similar to results predicted using the GPI scheme except in the regions of reversed flow. The hybrid algorithm is less efficient than the GPI algorithm but more robust. Dissert. Abstr.

N88-11638*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE ONSET OF THREE-DIMENSIONALITY AND TIME-DEPENDENCE IN THE GOERTLER VORTEX PROBLEM Final Report
Philip Hall and Sharon MacKerrell (Exeter Univ., England) Nov. 1987 40 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178404; ICASE-87-71; NAS 1.26:178404) Avail: NTIS HC A03/MF A01 CSCL 01A

The instability of large amplitude Goertler vortices in a growing boundary layer is discussed in the fully nonlinear regime. It is shown that a three-dimensional breakdown to a flow with wavy vortex boundaries similar to that which occurs in the Taylor vortex problem takes place. However, the instability is confined to the thin shear layers which have been shown to trap the region of vortex activity. The disturbance eigenfunctions decay exponentially away from the center of these layers so that the upper and lower shear layers can support independent modes of instability. The structure of the instability, in particular its location and speed of downstream propagation, is found to be entirely consistent with recent experimental results. Furthermore, it is shown that the upper and lower layers support wavy vortex instabilities with quite different frequencies. This result is again consistent with the available experimental observations. Author

N88-11639# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE GREEN'S FUNCTION METHOD FOR FULLY UNSTEADY AERODYNAMICS AROUND THREE-DIMENSIONAL BODIES AND ITS APPLICATION TO FLUTTER ANALYSIS
Qiangang Liu and Yongnian Yang Feb. 1986 33 p Sponsored by the Chinese government
(UTIAS-298; ISSN-0082-5255) Avail: NTIS HC A03/MF A01

A Green's function method for fully unsteady aerodynamics around three-dimensional bodies is outlined. The governing equation is a linear partial differential equation with the perturbation

velocity potential as its unknown function. Using the Green's theorem, this equation is transformed into an integro-differential equation. A brief discussion of the derivation of the Green's function and of the solution of the flutter equation is presented. Numerical solutions are obtained in the Laplace domain. The results are in good agreement with experimental data. Author

N88-11640*# Sikorsky Aircraft, Stratford, Conn.
AN EXPERIMENTAL EVALUATION OF ADVANCED ROTORCRAFT AIRFOILS IN THE NASA AMES ELEVEN-FOOT TRANSONIC WIND TUNNEL Contractor Report, Mar. 1982 - Apr. 1983
Robert J. Flemming Sep. 1984 162 p
(Contract MOA-14800-039)
(NASA-CR-166587; NAS 1.26:166587; SER-510106) Avail: NTIS HC A08/MF A01 CSCL 01A

Five full scale rotorcraft airfoils were tested in the NASA Ames Eleven-Foot Transonic Wind Tunnel for full scale Reynolds numbers at Mach numbers from 0.3 to 1.07. The models, which spanned the tunnel from floor to ceiling, included two modern baseline airfoils, the SC1095 and SC1094 R8, which have been previously tested in other facilities. Three advanced transonic airfoils, designated the SSC-A09, SSC-A07, and SSC-B08, were tested to confirm predicted performance and provide confirmation of advanced airfoil design methods. The test showed that the eleven-foot tunnel is suited to two-dimensional airfoil testing. Maximum lift coefficients, drag coefficients, pitching moments, and pressure coefficient distributions are presented. The airfoil analysis codes agreed well with the data, with the Grumman GRUMFOIL code giving the best overall performance correlation. M.G.

N88-11898# Joint Publications Research Service, Arlington, Va.
ANALYSIS OF COMPRESSIBLE FLOW ON HIGH-VELOCITY JET PENETRATION
Xiao Lin and Jihai Wang *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 1-11 Transl. into ENGLISH from Binggong Xuebao (Beijing, People's Republic of China), no. 3, Aug. 1986 p 20-27 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-11641# Sandia National Labs., Albuquerque, N. Mex.
MEASUREMENTS OF GAS VELOCITIES AND TEMPERATURES IN A LARGE OPEN POOL FIRE
M. E. Schneider and L. A. Kent 1987 44 p Presented at the 24th National Heat Transfer Conference and Exhibition, Pittsburgh, Pa., 9 Aug. 1987
(Contract DE-AC04-76DP-00789)
(DE87-005853; SAND-87-0095C; CONF-870816-6) Avail: NTIS HC A03/MF A01

There is an interest in determining the response and survivability of a variety of items subject to engulfment in a large fire which may occur in a transportation accident. In order to estimate this response, knowledge of the thermal and flow conditions prevailing in these pool fires is required. A total of approx.48,500 liters of JP-4 fuel was burned in a 9 x 18 meter pool, producing peak temperatures in excess of 1230 C (2250 F), over much of the instrumented region of the flame. As is often the case in fires of this size, the effects of mild ambient winds on the measurements were pronounced. Attempts have been made to mitigate these effects by the application of conditional sampling. Temperatures are compared with measurements made in other large aviation fuel fires. The measured velocities are slightly less than would be predicted from an empirical model that was developed from experimental results for methane diffusion flames that are orders of magnitude smaller. DOE

N88-11642 Civil Aviation Authority, London (England).
UK AIRMISS STATISTICS
1987 9 p
(CAP-530; ISBN-0-86039-311-9; ISSN-0951-6301; ETN-87-90963)
Copyright Avail: Issuing Activity

Airmiss totals (civil and military); commercial air transport airmisses; commercial air transport aircraft involved in airmisses; and commercial air transport airmisses related to flying hours for 1977 to 1986 in United Kingdom airspace are tabulated. ESA

N88-11643*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CIVIL APPLICATIONS OF HIGH-SPEED ROTORCRAFT AND POWERED-LIFT AIRCRAFT CONFIGURATIONS
James A. Albers and John Zuk Oct. 1987 28 p Prepared for presentation at the International Powered Lift Conference, Santa Clara, Calif., 7-10 Dec. 1987
(NASA-TM-100035; A-87339; NAS 1.15:100035) Avail: NTIS HC A03/MF A01 CSCL 01C

Advanced subsonic vertical and short takeoff and landing (V/STOL) aircraft configurations offer new transportation options for civil applications. Described is a range of vehicles from low-disk to high-disk loading aircraft, including high-speed rotorcraft, V/STOL aircraft, and short takeoff and landing (STOL) aircraft. The status and advantages of the various configurations are described. Some of these show promise for relieving congestion in high population-density regions and providing transportation opportunities for low population-density regions. Author

N88-11644*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL AIRCRAFT CONFIGURATIONS AND OPPORTUNITIES IN THE PACIFIC BASIN
James A. Albers and John Zuk Aug. 1987 31 p Presented at the 4th SAE International Pacific Conference on Automotive Engineering, Melbourne, Australia, 1 Dec. 1987
(NASA-TM-100005; A-87278; NAS 1.15:100005) Avail: NTIS HC A03/MF A01 CSCL 01C

Advanced aircraft configurations offer new transportation options for the Pacific Basin. Described is a range of vehicles from low-disk to high-disk loading aircraft, including high-speed rotorcraft, subsonic vertical and short takeoff and landing (V/STOL) aircraft, and subsonic short takeoff and landing (STOL) aircraft. The status and advantages of the various configurations are described. Some of these show promise for satisfying many of the transportation requirements of the Pacific Basin; as such, they could revolutionize short-haul transportation in that region. Author

N88-11645# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
SUMMARY REPORT OF THE HISTORY AND EVENTS PERTINENT TO THE CIVIL AEROMEDICAL INSTITUTE'S EVALUATION OF PROVIDING SMOKE/FUME PROTECTIVE BREATHING EQUIPMENT FOR AIRLINE PASSENGER USE Final Report
E. A. Higgins Jun. 1987 16 p
(AD-A184499; DOT/FAA/AM-87/5) Avail: NTIS HC A03/MF A01 CSCL 01C

This report presents a summary of the history and events pertinent to the Civil Aeromedical Institute's evaluation of the feasibility of providing smoke/fume protective breathing equipment for passenger use, including research undertaken, reports produced, and responses to requests for information. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-11646 Georgia Inst. of Tech., Atlanta.
ADVANCED DEAD RECKONING NAVIGATION FOR MOBILE ROBOTS Ph.D. Thesis
Larry E. Banta 1987 215 p
Avail: Univ. Microfilms Order No. DA8715811

The development of a navigation system for industrial automated vehicles that will allow them to operate without continuous guidepaths is described. The navigation system is based on the principle of dead reckoning (DR) with periodic position correction from landmark detection. The dead reckoning calculations are based on very accurate counts of the wheel turns. The landmarks are retroflective paper targets mounted on the ceiling which are located by an on-board video camera. The landmark information is combined with the DR position estimate by a Kalman filter. A prototype vehicle was constructed which is capable of navigating a path described by a series of commands read from a floppy disk. It has successfully negotiated a variety of paths, and has demonstrated DR random tracking errors of less than one percent of the travel distance. It was concluded that dead reckoning with landmark updating is a viable navigation for industrial and commercial automated vehicles. While vision was used for the landmark recognition in this project, a variety of other sensor types are possible, and expansion of the machine's sensor options is encouraged as an extension of the research. Dissert. Abstr.

N88-11647# Massachusetts Univ., Amherst. Dept. of Computer and Information Science.
DYNAMIC IMAGE INTERPRETATION FOR AUTONOMOUS VEHICLE NAVIGATION Annual Report, 26 Feb. 1986 - 25 Feb. 1987
E. M. Riseman, A. R. Hanson, and L. J. Kitchen May 1987 32 p
(Contract DACA76-85-C-0008)
(AD-A184043; ETL-0463) Avail: NTIS HC A03/MF A01
CSCL 17G

In pursuit of the goal of achieving dynamic image interpretation for autonomous vehicle navigation, we have made significant progress in the knowledge-based interpretation of road scenes, in visual motion analysis, and in mobile robot navigation. This work has been supported by development of necessary software, tools, installation of appropriate hardware, and concurrent investigations into applicable techniques for image analysis. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N88-11648*# Titan Systems, Inc., La Jolla, Calif.
IMPROVEMENTS TO THE ADAPTIVE MANEUVERING LOGIC PROGRAM Final Report
George H. Burgin Washington Jun. 1986 189 p
(Contract NAS2-11421)
(NASA-CR-3985; H-1303; NAS 1.26:3985) Avail: NTIS HC A09/MF A01 CSCL 01C

The Adaptive Maneuvering Logic (AML) computer program simulates close-in, one-on-one air-to-air combat between two fighter aircraft. Three important improvements are described. First, the previously available versions of AML were examined for their suitability as a baseline program. The selected program was then revised to eliminate some programming bugs which were uncovered over the years. A listing of this baseline program is included. Second, the equations governing the motion of the aircraft were completely revised. This resulted in a model with substantially higher fidelity than the original equations of motion provided. It also completely eliminated the over-the-top problem, which occurred in the older versions when the AML-driven aircraft attempted a vertical or near vertical loop. Third, the requirements for a versatile generic, yet realistic, aircraft model were studied and implemented in the program. The report contains detailed tables which make the generic aircraft to be either a modern, high performance aircraft, an older high performance aircraft, or a previous generation jet fighter. Author

N88-11649# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
ROTORCRAFT DESIGN FOR OPERATIONS
Jun. 1987 319 p In ENGLISH and FRENCH Symposium held in Amsterdam, Netherlands, 13-16 Oct. 1986
(AGARD-CP-423; ISBN-92-835-0420-8) Avail: NTIS HC A14/MF A01

The objective was to explore the impact of operational needs on the evolution of rotorcraft design. The status of rotorcraft design is reviewed and priorities and neglected topics are discussed. For individual titles, see N88-11650 through N88-11672.

N88-11650# Army Aviation Systems Command, St. Louis, Mo.
THE INFLUENCE OF OPERATIONAL REQUIREMENTS ON LHX CONCEPT FORMULATION
Robert D. Hubbard and Robert L. Tomaine *In* AGARD, Rotorcraft Design for Operations Jun. 1987 8 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The U.S. Army's Light Helicopter Family (LHX) program which is currently in concept formation is discussed. The activities associated with concept formation including governing regulations, how the process is executed, the scope of the effort involved and innovations included for LHX are discussed. The evolution of the requirements is emphasized and the focus is on how the operational requirements drive the engineering requirements and ultimately the design of the aircraft. Operational requirements are driven by the LHX concept, namely, a family of Scout/Attack (LHX/SCAT) and Utility (LHX-U) aircraft with common dynamic components, core mission equipment and common subsystems. The impacts of the unique LHX-SCAT aircraft on the design of and commonality with the LHX-U are discussed. The operational requirements are categorized into those associated with the Army 21 concept of the future battlefield, the threat, safety and reliability, and availability and maintainability. Each category results in several specific design impacts. Author

N88-11651# KLM Helikopters B.V., Amsterdam (Netherlands).
DESIGN REQUIREMENTS FOR FUTURE COMMERCIAL OPERATIONS
F. F. J. Schaper *In* AGARD, Rotorcraft Design for Operations Jun. 1987 14 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

Design requirements for helicopters stemming from civil operations are discussed. The offshore oil and gas industry is and will continue to be the main application of civil helicopters. Development of other commercial markets will require major improvements in almost all areas. Some of these areas are highlighted, including: safety, reliability, cockpit ergonomics, and vibration. The current rate of progress is considered to be much too slow and concern is expressed about military and civil requirements drifting too far apart. Designers of new military helicopters should be aware of these civil requirements and take them into account as much as possible. Author

N88-11652# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
MISSION-ORIENTED FLYING QUALITIES CRITERIA FOR HELICOPTER DESIGN VIA IN-FLIGHT SIMULATION
B. Gmelin, H.-J. Pausder, and P. Hamel *In* AGARD, Rotorcraft Design for Operations Jun. 1987 14 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

Some recent activities and results in the fields of rotorcraft in-flight simulation are presented. The following general conclusions were drawn: (1) general purpose in-flight simulators will play a decisive role in the rotorcraft design, evaluation, development, and certification process; (2) the capability of in-flight simulators will support industry to meet the demands for future rotorcraft systems and to reduce the costs and risks of development programs; and (3) for the generation of generic flying qualities, test vehicles providing adequate mission performance and variable characteristics are required. Author

N88-11653# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
INVESTIGATION OF VERTICAL AXIS HANDLING QUALITIES FOR HELICOPTER HOVER AND NOE FLIGHT **c08**
S. W. Baillie and J. M. Morgan *In* AGARD, Rotorcraft Design for Operations Jun. 1987 9 p Sponsored in part by Canadian Department of National Defense (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The preliminary results of two in-flight simulation programs on vertical axis rotorcraft handling qualities are presented. The parameters investigated in these studies were heave damping, thrust to weigh ratio (T/W), and a number of dynamic engine governor/rotor system models. Flight tasks include hover, hover maneuvering and nap of the Earth (NOE) flight. Evaluation of nine heave damping, thrust to weight ratio configurations provides the basis to suggest Level 1 Z sub w and T/W boundary values of -0.20 sec -1 and 1.08 respectively. These boundaries are compared with other relevant work on the topic. The engine governor/rotor system evaluation results tend to disagree with handling qualities predictions based on a vertical velocity shaping parameter. Author

N88-11654# Systems Technology, Inc., Hawthorne, Calif.
HANDLING QUALITIES CRITERION FOR VERY LOW VISIBILITY ROTORCRAFT **c08**
Roger H. Hoh *In* AGARD, Rotorcraft Design for Operations Jun. 1987 15 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

This research was conducted to investigate the required visual cueing for low speed and hover and to determine if an increase in stabilization can effectively be used to compensate for the loss of essential cues. Two flight test experiments were conducted using a conventional helicopter and a variable stability helicopter, as well as electronically fogged lenses and night vision goggles with daylight training filters. The primary conclusion regarding the essential cues for hover was that fine grained texture is more important than large discrete objects or field of view. The use of attitude command augmentation was found to be effective as a way to make up for display deficiencies. However, a corresponding loss of agility occurred with the tested attitude command/attitude hold system resulting in unfavorable pilot comments. Hence, the favorable control display tradeoff must be interpreted in the context that the best solution would be to improve the vision aid. Such an improvement would require an increase in the visual microtexture, an advancement in display technology that is unlikely to be available in the foreseeable future. Therefore, a criterion was developed to systematically evaluate display quality and the associated upgrade in required stabilization as a function of increasingly degraded visual cues. Author

N88-11655# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
MBB SIMULATION FACILITIES APPLIED FOR ROTORCRAFT RESEARCH **c09**
Peter Krausep, James vanGaasbeek, and Horst Borchert *In* AGARD, Rotorcraft Design for Operations Jun. 1987 17 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The increasing pilot workload and environmental conditions of modern military helicopters necessitate detailed assessment of cockpit designs with regard to controls and displays. The optimization must be performed at the initialization of the concept to insure a harmonic design with minimum pilot workload. The status of the MBB Munich flight simulation facility is examined closely in light of these challenging requirements. Projections of the future development of the simulation center components are depicted, as well as priorities. Author

N88-11656# Centre d'Essais en Vol, Istres (France).
RESEARCH SIMULATORS FOR HELICOPTERS [SIMULATEURS D'ETUDES POUR HELICOPTERES] **c09**
D. Jerome *In* AGARD, Rotorcraft Design for Operations Jun. 1987 12 p In FRENCH (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The helicopter simulation facilities of the Centre d'Essais en Vol at Istres are described. The simulator cabins, imaging techniques, motion simulator methods, and related computer equipment are described. In addition, the Center's research objectives in the areas of vehicle and systems design, crew station organization, and vehicle performance evaluation are outlined. M.G.

N88-11657# Army Aviation Research and Development Command, Moffett Field, Calif.
MODELING XV-15 TILT-ROTOR AIRCRAFT DYNAMICS BY FREQUENCY AND TIME DOMAIN IDENTIFICATION TECHNIQUES
Mark B. Tischler and Juergen Kaletka (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, West Germany) *In* AGARD, Rotorcraft Design for Operations Jun. 1987 20 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

Models of the open-loop hover dynamics of the XV-15 Tilt-Rotor Aircraft are extracted from flight data using two approaches: frequency domain and time-domain identification. Both approaches are reviewed and the identification results are presented and compared in detail. The extracted models are compared favorably, with the differences associated mostly with the inherent weighing of each technique. Step responses are used to show that the predictive capability of the models from both techniques is excellent. Based on the results of this study, the relative strengths and weaknesses of the frequency and time-domain techniques are summarized and a proposal for a coordinated parameter identification approach is presented. Author

N88-11658# Royal Aircraft Establishment, Farnborough (England).
OPERATIONAL LOAD MEASUREMENTS ON SERVICE HELICOPTERS
Dorothy M. Holford *In* AGARD, Rotorcraft Design for Operations Jun. 1987 12 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The philosophy of operational load measurement programs as applied to rotary wing aircraft is reviewed. A major aim is to substantiate component fatigue lives in the light of operational usage. The aircraft installation to meet the needs of the programs is described. The analysis techniques, which are designed to provide the operator and engineer with a view of the origins of fatigue damage, are described. Problem areas in comprehensive fatigue monitoring systems are discussed. Author

N88-11659# Royal Aircraft Establishment, Bedford (England). Flight Systems Div.
THE FLIGHT EVALUATION OF AN ADVANCED ENGINE DISPLAY AND MONITORING SYSTEM **c06**
L. Adams *In* AGARD, Rotorcraft Design for Operations Jun. 1987 10 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

A Wessex helicopter was used to develop and evaluate a suite of advanced, integrated avionics. An important area of study was concerned with the display of engine and transmission data, and with a system monitor which gives audio and visual warning of any problems. The system demonstrated that the suppression of engine and transmission data at all times except when the pilot asks for it to be displayed or the system detects a problem is an acceptable technique. Author

N88-11660# Societe Nationale Industrielle Aerospatiale, Marignane (France). Dept. Systemes.
ACTIVE CONTROL OF HELICOPTER VIBRATION USING MULTILOOP SELF-ADAPTIVE CONTROL [CONTROLE ACTIF DES VIBRATIONS SUR HELICOPTERE PAR COMMANDS MULTICYCLIQUES AUTOADAPTATIVES] **c08**
Marc Achache and Michel Gauvrit (Centre d'Etudes et de Recherches, Toulouse, France) *In* AGARD, Rotorcraft Design for Operations Jun. 1987 10 p In FRENCH
(For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

A research program for the development of a trial multiloop control system for the active control of vibration in the main rotor blades is described. This experimentation consists of the most significant applications of self-adaptive control techniques to stochastic systems. The various stages of the program are discussed, from the research on the theoretical model of helicopter vibratory behavior under the influence of multiloop control, to the system flight tests. M.G.

N88-11661# Textron Bell Helicopter, Fort Worth, Tex.
CONTROLLING THE DYNAMIC ENVIRONMENT DURING NOE FLIGHT **c08**
Dennis R. Halwes *In* AGARD, Rotorcraft Design for Operations Jun. 1987 9 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

A six degree-of-freedom isolation system using six Liquid Inertia Vibration Eliminator (LIVE) units was installed on a Bell 206LM helicopter. The system was named the Total Rotor Isolation System (TRIS). To determine the effectiveness of TRIS in reducing helicopter vibrations, a flight verification syudy was conducted. The objective was to demonstrate a 90 percent (or greater) isolation of the helicopter fuselage from the main rotor forces and moments transmitted at the blade passage frequency, which is 4/rev in the case of the Bell 206LM. The flight test data indicate that the objectives were surpassed. Author

N88-11662# Westland Helicopters Ltd., Yeovil (England).
MINIMISATION OF HELICOPTER VIBRATION THROUGH ACTIVE CONTROL OF STRUCTURAL RESPONSE **c08**
S. P. King and A. E. Staple *In* AGARD, Rotorcraft Design for Operations Jun. 1987 13 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The current demonstration and installation of the Activa Control Structural Response (ACSR) technique on a Westland 30 helicopter is discussed. The technique employs high frequency force actuation within the helicopter's structure. These forces are superposed onto the dominant vibratory forces in an active manner, such that the fuselage vibratory response is minimized. The basic control philosophy for ACSR is described and the current experimental demonstration status is detailed. Author

N88-11663# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
IMPACTS OF ROTOR HUB DESIGN CRITERIA ON THE OPERATIONAL CAPABILITIES OF ROTORCRAFT SYSTEMS
R. Schindler and E. Pfisterer *In* AGARD, Rotorcraft Design for Operations Jun. 1987 23 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

Starting with the description of the different design principles of articulated, see-saw, hingeless and bearingless rotor concepts, a variety of realized constructions is presented and discussed. The flight mechanic aspects such as maneuverability and handling qualities are explained with respect to their operational capabilities. The differences in the flapping hinge offset are discussed. The tend of the flapping hinge offset over three decades of armed and utility helicopters is analysed. Author

N88-11664# Societe Nationale Industrielle Aerospatiale, Marignane (France). Helicopter Div.
NEW AERODYNAMIC DESIGN OF THE FENESTRON FOR IMPROVED PERFORMANCE
A. Vuillet and F. Morelli *In* AGARD, Rotorcraft Design for Operations Jun. 1987 11 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

A general definition of the fenestron and its advantages for civil and military helicopters are given. A detailed airflow analysis through the fenestron was recently achieved on the tail rotor bench in hover. The experimental technique and the flow measurements are surveyed. Also presented are the correlations made with blade element theory as well as more advanced analysis derived from a radial equilibrium code in use for compressors. Author

N88-11665# Sikorsky Aircraft, Stratford, Conn. Research and Advanced Design.
ROTORCRAFT DESIGNS FOR THE YEAR 2000
Evan A. Fradenburgh *In* AGARD, Rotorcraft Design for Operations Jun. 1987 11 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

Some of the rotorcraft concepts that can offer higher speeds than the pure helicopter, including the compound helicopter, ABC, tilt-rotor, X-wing, and stowed rotor configurations are discussed. All of these are potentially practical aircraft. Economic considerations will dictate that the pure helicopter is here to stay; higher speed rotorcraft are not as cost effective at short distances. Also examined is the approach to helicopter sizing for heavy-lift applications. It is concluded that a super-large helicopter, sized to carry the heaviest payload needed, is unaffordable. A better solution is to develop a moderately large helicopter that will carry most of the required loads, and to use the twin-lift technique to transport the occasional extra-heavy load. Author

N88-11666# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
HELICOPTER (PERFORMANCE) MANAGEMENT
Winfried Benner and Rolf Duessman *In* AGARD, Rotorcraft Design for Operations Jun. 1987 9 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The next generation of military helicopters will have to fly under night and adverse weather conditions below tree top level. Dornier System started 15 years ago to develop avionic systems with a performance that would allow pilots to fly the new missions. In the Dornier baseline display cockpit concept the first steps of the Helicopter Management System (HMS) will be realized. Here, the main aspects of the system are discussed. The main parts are the mission planning system on the ground and the HMS onboard the helicopter. Author

N88-11667# Societe de Fabrication d'Instruments de Mesure, Massy (France).
HELICOPTER FIRE CONTROL: ADVANTAGES OF AN AUTOMATIC TARGET TRACKER [CONDUITE DE TIR HELICOPTERE INTERETS D'UNE POURSUITE AUTOMATIQUE DE CIBLE] **c09**
B. Cerutti *In* AGARD, Rotorcraft Design for Operations Jun. 1987 5 p In FRENCH (For primary document

see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

Several advantages of target tracking as applied to helicopter fire control are discussed. The principle elements involved in fire control (sighting, armaments and computers) and their respective roles in target acquisition are briefly described. The benefits of automatic target tracking with image processing are examined in terms of operator workload, improvement in tracking rate and noise, and improvement in target kinetic information (precision, noise) for fire control. Finally, the various criteria for control design are presented. M.G.

N88-11668# Royal Netherlands Air Force, The Hague.
DEVELOPMENT, TESTING AND EVALUATION OF A NIGHT VISION GOGGLE COMPATIBLE BO-105 FOR NIGHT LOW LEVEL OPERATION **c54**
R. H. Friedericy *In* AGARD, Rotorcraft Design for Operations Jun. 1987 8 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

With the recommended equipment package, it was demonstrated that a BO-105 helicopter could be operated by experienced helicopter pilots at low level at night over fairly unfamiliar terrain under adverse weather conditions. The helmet mounted night vision goggles (NVG) gave a night low level capability. The third generation image intensifying tube (IIT) added an extra darkness and reduced visibility margin. The blue NVG cockpit lighting made easy monitoring of flight and engine performance instruments possible and allowed the use of navigation equipment. This greatly improved confidence and reduced workload. Author

N88-11669# Costruzioni Aeronautiche Giovanni Agusta S.p.A., Varese (Italy).
A129 ADVANCED SOLUTIONS FOR MEETING TODAY'S COMBAT HELICOPTER REQUIREMENT
Giuseppe Virtuani *In* AGARD, Rotorcraft Design for Operations Jun. 1987 9 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

It is argued that the A129 light attack helicopter represents the answer to modern and severe operational requirements. The main rotar hub and transmission are described as examples of unconventional and advanced technology design. The engine installation represents the case of a configuration where the operative requirement induced a deep physical integration among the subsystems. The large computer structure, the integrated multiplexing system based on the multiplexing and microprocessor technologies, constitutes a major example of functional integration between the helicopter and mission subsystem. Author

N88-11670# McDonnell-Douglas Helicopter Co., Mesa, Ariz. Advanced Engineering.
APACE FOR THE BATTLEFIELD OF TODAY AND THE 21ST CENTURY
James B. Rorke *In* AGARD, Rotorcraft Design for Operations Jun. 1987 13 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The AH-64A Apache is in service with the U.S. Army. The operational requirements which drove the the design of the Apache and caused this particular combination of attributes are documented. The attributes discussed include performance, survivability, crashworthiness, transportability, deployability, navigation, target acquisition and weapon systems. Author

N88-11671# Societe Nationale Industrielle Aerospatiale, Marignane (France). Div. Helicoptere.
SYSTEM FOR SAR MISSIONS [SYSTEME DE MISSION SAR] **c06**
S. Rioche *In* AGARD, Rotorcraft Design for Operations Jun. 1987 10 p In FRENCH; In FRENCH (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The helicopter division of Aerospatiale developed a specially adapted system for search and rescue (SAR) missions at sea. The system allows entirely automatic piloting and guidance, particularly during the execution of search patterns and the descent to hovering flight in the proximity of the target. An electronic flight instrument system (EFIS) panel includes cathode screen displays for attitude, horizontal situation parameters, and search radar data. The horizontal situation parameters are selected as a function of the phase of flight from four modes: horizontal situation indicator, sector with or without superimposed radar data, search pattern, and hover. M.G.

N88-11672# Agusta S.p.A., Milan (Italy).
THE EH-101 INTEGRATED PROJECT: A NAVAL, UTILITY AND COMMERCIAL HELICOPTER SYSTEM
Pietro Alli, Ruggero Baldassarrini, Giovanni Marzorati, Giovanni Pagliaro, and Luciano Armiti *In* AGARD, Rotorcraft Design for Operations Jun. 1987 32 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

The Royal Navy and Marina Militare Italiana tasked EHI to develop a new shipborne helicopter. The two Navies defined a common set of requirements related to the basic common helicopter plus a dedicated different set for each specific mission. Concurrently EHI performed autonomous research on the potential EH 101 civil and utility market. Through those analysis EHI came to the conclusion that a common basic helicopter could satisy all of the requirements even if the roles were sometimes very different. The rationale and the trade off approach which were successfully devised and implemented to produce an aircraft with the best compromise of performance and cost are given. Author

N88-11673# Vibration Inst., Clarendon Hills, Ill.
THE SHOCK AND VIBRATION DIGEST, VOLUME 19, NO. 11 Monthly Report
Judith Nagle-Eshleman, ed. Nov. 1987 56 p
Avail: NTIS HC A04/MF A01

The airworthiness of a long-life jet transport structure is discussed. The book review of Dynamic Fracture is presented. Also included are abstracts for the following subjects: machines; structures; vehicles; testing systems; mechanical components; structural components; materials; experimental techniques; mathematical models; computational methods; modeling techniques; design; and criteria, standards, and specifications. For individual titles, see N88-11674 through N88-11674.

N88-11674# Boeing Commercial Airplane Co., Seattle, Wash.
AIRWORTHINESS OF LONG-LIFE JET TRANSPORT STRUCTURES
U. G. Goranson *In* Vibration Inst., The Shock and Vibration Digest, Volume 19, No. 11 Nov. 1987 p 3-14 (For primary document see N88-11673 03-05)
Avail: NTIS HC A04/MF A01

The criteria and procedures used to design long-life damage-tolerant aircraft structures are outlined. A damage tolerance rating system allows recognition of opportunities for damage detection in a fleet of aircraft. The system is an efficient measure of operator inspection activities and allows coordinated manufacturer, operator, and certifying agency actions to assure continuing structural airworthiness. Author

N88-11675# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Mathematische Verfahren und Datentechnik.
REVISION OF THE INFORMATION STANDARDS FOR FLIGHT MECHANICS
Gerhard Rosenau Apr. 1987 149 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1079)
(DFVLR-Mitt-87-06; ISSN-0176-7739; ETN-87-90592) Avail: NTIS HC A07/MF A01; DFVLR, Cologne, West Germany DM 51

The series of standards DIN 9300 concerning concepts, quantities and symbols for flight dynamics is presented. The series

is based on and agrees in structure and content with ISO 1151.
ESA

N88-11676*# United Technologies Research Center, East Hartford, Conn.
ANALYTIC INVESTIGATION OF HELICOPTER ROTOR BLADE APPENDED AEROELASTIC DEVICES
Richard L. Bielawa Feb. 1984 96 p
(Contract NAS2-11008)
(NASA-CR-166525; NAS 1.26:166525; UTRC-R84-915774-24)
Avail: NTIS HC A05/MF A01 CSCL 01C

Analytic evaluations of four different passive aeroelastic devices appended to helicopter rotor blades are presented. The devices consist of a passive tuned tab, a control coupled tab, an all-flying tip and a harmonic dilational airfoil tip. Each device was conceived for improving either aerodynamic performance or reducing vibratory control loads or hub shears. The evaluation was performed using a comprehensive rotor aeroelastic analysis (the G400PA code with appropriate modifications), together with data for a realistic helicopter rotor blade (the UH-60A Blackhawk), in high speed flight (90 m/s, 175 kts). The results of this study show that significant performance (L/(D sub e)) gains can be achieved with the all-flying free tip. Results from the harmonic dilational airfoil tip show the potential for moderate improvements in L/(D sub e). Finally, the results for the passive tuned tab and the control coupled tab, as configured for this study, show these devices to be impractical. Sections are included which describe the operation of each device, the required G400PA modifications, and the detailed results obtained for each device. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-11677# European Space Agency, Paris (France).
THE AVIONICS FLIGHT EVALUATION SYSTEM (AFES) OF THE DFVLR
Karlheinz Hurrass and Peter Schulz Jul. 1987 87 p Transl. into ENGLISH of Das Avionik-Flugprobungssystem (AFES) der DFVLR (Brunswick, Federal Republic of Germany) Original language document was previously announced as N85-27864
(ESA-TT-1037; DFVLR-Mitt-85-01; ETN-87-91116) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 23

A real time avionics flight evaluation system using a laser radar unit instead of recording theodolites was designed. The inertial navigation system on board the test platform, the tracking radar, and sensors are integrated via a Kalman filter by a computer in the test aircraft. Before the measurement results of the ground sensors are up linked to the aircraft, they are preprocessed in a computer belonging to the radar units. Accuracies of up to 0.1 m for position and up to 0.01 m/sec for velocity are achieved in determining the reference flight path. Determination of the reference data is almost continuous. Multipath propagation disturbance factor is measured by a subsystem. Another subsystem simulates a particular number of users of a navigation system.
ESA

N88-11678# European Space Agency, Paris (France).
EFFECT OF INSTALLATION AND CALIBRATION ERRORS OF SENSORS ON SYSTEM IDENTIFICATION RESULTS OF AN AIRCRAFT
Ruthard Koehler Jul. 1987 34 p Transl. into ENGLISH of Einfluss der Einbau- und Kalibrierungsfehler von Sensoren auf Systemidentifizierungs- Ergebnisse eines Flugzeugs (Brunswick, Federal Republic of Germany) Original language document was previously announced as N87-26043
(ESA-TT-1059; DFVLR-FB-86-50; ETN-87-91125) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 14.50

The effect of errors in the position attitude, and calibration of aircraft flight test instruments used for system identification was investigated. For system identification of rigid body motions of an aircraft, accelerometers, gyroscopes, and flow sensors are used. Their positions and attitudes are defined with respect to body-fixed axes. A general procedure for the determination of the effect of installation errors on the results is presented. Calibration, position and attitude errors of accelerometers, gyroscopes, and flow sensors are treated and quantitatively demonstrated. ESA

N88-11659# Royal Aircraft Establishment, Bedford (England). Flight Systems Div.
THE FLIGHT EVALUATION OF AN ADVANCED ENGINE DISPLAY AND MONITORING SYSTEM
L. Adams *In* AGARD, Rotorcraft Design for Operations Jun. 1987 10 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11671# Societe Nationale Industrielle Aerospatiale, Marignane (France). Div. Helicoptere.
SYSTEM FOR SAR MISSIONS [SYSTEME DE MISSION SAR]
S. Rioche *In* AGARD, Rotorcraft Design for Operations Jun. 1987 10 p In FRENCH (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-11679*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST STAND PERFORMANCE OF A CONVERTIBLE ENGINE FOR ADVANCED V/STOL AND ROTORCRAFT PROPULSION
Jack G. McArdle 1987 22 p Presented at the International Powered Lift Conference, Santa Clara, Calif., 7-10 Dec. 1987; sponsored by the Society of Automotive Engineers
(NASA-TM-100211; E-3819; NAS 1.15:100211) Avail: NTIS HC A03/MF A01 CSCL 21E

A variable inlet guide vane (VIGV) convertible engine that could be used to power future high-speed V/STOL and rotorcraft was tested on an outdoor stand. The engine ran stably and smoothly in the turbofan, turboshaft, and dual (combined fan and shaft) power modes. In the turbofan mode with the VIGV open, fuel consumption was comparable to that of a conventional turbofan engine. In the turboshaft mode with the VIGV closed, fuel consumption was higher than that of present turboshaft engines because power was wasted in churning fan-tip air flow. In dynamic performance tests with a specially built digital engine control and using a waterbrake dynamometer for shaft load, the engine responded effectively to large steps in thrust command and shaft torque. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-11680*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT PROPULSION CONTROL INTEGRATION FOR V/STOL AIRCRAFT
James R. Mihaloew 1987 22 p Presented at the International Powered Lift Conference, Santa Clara, Calif., 7-10 Dec. 1987; sponsored by the Society of Automotive Engineers
(NASA-TM-100226; E-3845; NAS 1.15:100226) Avail: NTIS HC A03/MF A01 CSCL 01C

The goal of the propulsion community is to have the enabling propulsion technologies in place to permit a low risk decision regarding the initiation of a research STOVL supersonic attack fighter aircraft in the mid-1990's. This technology will effectively integrate, enhance, and extend the supersonic cruise, STOVL, and fighter/attack programs to enable U.S. industry to develop a revolutionary supersonic short takeoff vertical landing fighter/attack aircraft in the post-ATF period. The rationale, methods, and criteria used in developing a joint NASA Lewis and NASA Ames research program to develop the technology element for integrated flight propulsion control through integrated methodologies is presented. This program, the Supersonic STOVL Integrated Flight Propulsion Controls Program, is part of the overall NASA Lewis Supersonic STOVL integrated approach to an integrated program to achieve integrated flight propulsion control technology. Author

N88-11653# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
INVESTIGATION OF VERTICAL AXIS HANDLING QUALITIES FOR HELICOPTER HOVER AND NOE FLIGHT
S. W. Baillie and J. M. Morgan *In* AGARD, Rotorcraft Design for Operations Jun. 1987 9 p Sponsored in part by Canadian Department of National Defense (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11654# Systems Technology, Inc., Hawthorne, Calif.
HANDLING QUALITIES CRITERION FOR VERY LOW VISIBILITY ROTORCRAFT
Roger H. Hoh *In* AGARD, Rotorcraft Design for Operations Jun. 1987 15 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11660# Societe Nationale Industrielle Aerospatiale, Marignane (France). Dept. Systemes.
ACTIVE CONTROL OF HELICOPTER VIBRATION USING MULTILOOP SELF-ADAPTIVE CONTROL [CONTROLE ACTIF DES VIBRATIONS SUR HELICOPTERE PAR COMMANDS MULTICYCLIQUES AUTOADAPTATIVES]
Marc Achache and Michel Gauvrit (Centre d'Etudes et de Recherches, Toulouse, France) *In* AGARD, Rotorcraft Design for Operations Jun. 1987 10 p In FRENCH (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11661# Textron Bell Helicopter, Fort Worth, Tex.
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Dennis R. Halwes *In* AGARD, Rotorcraft Design for Operations Jun. 1987 9 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11662# Westland Helicopters Ltd., Yeovil (England).
MINIMISATION OF HELICOPTER VIBRATION THROUGH ACTIVE CONTROL OF STRUCTURAL RESPONSE
S. P. King and A. E. Staple *In* AGARD, Rotorcraft Design for Operations Jun. 1987 13 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-11681# European Space Agency, Paris (France).
THE 0.6M X 0.6M TRISONIC TEST SECTION (TMK) OF DFVLR IN COLOGNE-PORZ, FEDERAL REPUBLIC OF GERMANY (STATUS 1986)
Helmut Esch Jun. 1987 89 p Transl. into ENGLISH of Die 0.6-m x 0.6-m-Trisonische Messtreccke (TMK) der DFVLR in Koeln-Porz (Stand 1986) (Cologne, Fed. Republic of Germany, DFVLR), Mar. 1986 Original language document was announced as N87-26053
(ESA-TT-1052; DFVLR-Mitt-86-21; ETN-87-90874) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 46.50

Information for users of a blowdown wind tunnel is provided. It has a Mach number range from 0.5 to 4.5, with Reynolds numbers, based on a reference length of 1m, between 10 million and 90 million. Typical running times are 60 sec. The Mach number range is extended by the neighboring hypersonic wind tunnel H2K, in which the same models can be tested at Mach numbers up to 11. ESA

N88-11682# European Space Agency, Paris (France).
THE VERTICAL TEST SECTION (VMK) OF DFVLR IN COLOGNE-PORZ, FEDERAL REPUBLIC OF GERMANY (STATUS 1986)
Klaus Triesch and Ernst-Otto Krohn Jun. 1987 101 p Transl. into ENGLISH of Die Vertikale Messtrecke (VMK) der DFVLR in Koeln-Porz (Stand 1986) (Cologne, Fed. Republic of Germany, DFVLR), May 1986 Original language document was announced as N87-26054
(ESA-TT-1053; DFVLR-Mitt-86-22; ETN-87-90875) Avail: NTIS HC A06/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 38

Information for users of a vertical test section blowdown wind tunnel with test section diameters from 150 to 340 mm is presented. The axisymmetric free jet has a Mach number range from 0.5 to 0.95 at subsonic speeds, and from 1.57 to 3.23 at supersonic speeds, with Reynolds numbers, based on a reference length of 1 m, between 3 million and 300 million. Typical testing times are between 30 and 60 sec. ESA

N88-11683 British Aerospace Aircraft Group, Preston (England). Military Aircraft Div.
THE ABILITY OF MODIFIED PAVEMENT QUALITY CONCRETE TO RESIST GROUND EROSION CAUSED BY VTOL AIRCRAFT
A. P. Winstanley Apr. 1987 25 p Original contains color illustrations
(BAe-ARG-238; ETN-87-90936) Copyright Avail: Issuing Activity

A fiber reinforced pavement quality concrete (FR PQC) was compared with the normal mix (N PQC) for VTOL aircraft use. The FR PQC lasts slightly longer before the onset of erosion. The FR PQC achieves a slightly higher surface temperature before erosion ensues. The area of erosion after a 40 sec run is less for the FR PQC. The exposed stainless steel fiber area revealed under a FR PQC spall is undesirable with respect to personnel and aircraft tires. Although the FR PQC performs slightly better than the N PQC, this cannot be totally conclusive from such a small sample study. It is possible that the slight gain in performance

of the FR PQC sample is due to the reduction of aggregate size, rather than the inclusion of fibers. ESA

N88-11684 Iowa State Univ. of Science and Technology, Ames.
THEORETICAL AND EXPERIMENTAL STUDY OF FLOW-CONTROL DEVICES FOR INLETS OF INDRAFT WIND TUNNELS Ph.D. Thesis
James Carl Ross 1987 131 p
Avail: Univ. Microfilms Order No. DA8716812

Low-contraction ratio wind tunnel inlets have been shown to generate nonuniform velocity fields in the location where it is necessary to place anti-turbulence screens. The pressure drop experienced by the flow passing through the screens is proportional to the local dynamic pressure and can, therefore, result in a nonuniform test-section velocity distribution. The interaction of screens and two-dimensional inlet flow was examined both theoretically and experimentally. The results indicate that the addition of more screens does not improve the test-section velocity distribution except for a very limited range of inlet geometries. In addition, the turning of the flow by the screens was found to be the most important factor influencing the inlet flow distribution and that the turning action of the screens must be included in any analysis of this type of flow. The use of a set of tuning vanes (cascade) upstream of the screens was found to be effective in modifying the inlet flow distribution so as to generate a uniform test-section velocity distribution. A successful application of the inlet cascade to the 80- by 120-Foot Wind Tunnel at NASA Ames Research Center is also presented. Dissert. Abstr.

N88-11685*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN AERODYNAMIC PERFORMANCE EVALUATION OF THE NASA/AMES RESEARCH CENTER ADVANCED CONCEPTS FLIGHT SIMULATOR M.S. Thesis
Paul F. Donohue Jun. 1987 113 p Prepared in cooperation with NPS, Monterey, Calif.
(NASA-TM-89659; NAS 1.15:89659; AD-A184700) Avail: NTIS HC A06/MF A01 CSCL 14B

The results of an aerodynamic performance evaluation of the National Aeronautics and Space Administration (NASA)/Ames Research Center Advanced Concepts Flight Simulator (ACFS), conducted in association with the Navy-NASA Joint Institute of Aeronautics, are presented. The ACFS is a full-mission flight simulator which provides an excellent platform for the critical evaluation of emerging flight systems and aircrew performance. The propulsion and flight dynamics models were evaluated using classical flight test techniques. The aerodynamic performance model of the ACFS was found to realistically represent that of current day, medium range transport aircraft. Recommendations are provided to enhance the capabilities of the ACFS to a level forecast for 1995 transport aircraft. The graphical and tabular results of this study will establish a performance section of the ACFS Operation's Manual. GRA

N88-11655# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
MBB SIMULATION FACILITIES APPLIED FOR ROTORCRAFT RESEARCH
Peter Krausep, James vanGaasbeek, and Horst Borchert *In* AGARD, Rotorcraft Design for Operations Jun. 1987 17 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11656# Centre d'Essais en Vol, Istres (France).
RESEARCH SIMULATORS FOR HELICOPTERS [SIMULATEURS D'ETUDES POUR HELICOPTERES]
D. Jerome *In* AGARD, Rotorcraft Design for Operations Jun. 1987 12 p In FRENCH (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

N88-11667# Societe de Fabrication d'Instruments de Mesure, Massy (France).
HELICOPTER FIRE CONTROL: ADVANTAGES OF AN AUTOMATIC TARGET TRACKER [CONDUITE DE TIR HELICOPTERE INTERETS D'UNE POURSUITE AUTOMATIQUE DE CIBLE]
B. Cerutti *In* AGARD, Rotorcraft Design for Operations Jun. 1987 5 p In FRENCH (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-11686*# Rockwell International Corp., Downey, Calif. Space Transportation Systems Div.
ORBITAL SPACECRAFT CONSUMABLES RESUPPLY SYSTEM (OSCRS). VOLUME 4: EXTENDED STUDY RESULTS Final Report
Sep. 1987 120 p
(Contract NAS9-17584)
(NASA-CR-172012; NAS 1.26:172012; STS-86-0302-4-Vol-4; DRD-10-Vol-4; CDRL-MA-1023T-Vol-4) Avail: NTIS HC A06/MF A01 CSCL 22A

The objectives consisted of three major tasks. The first was to establish the definition of Space Station and Orbital Maneuvering Vehicle (OMV) user requirements and interfaces and to evaluate system requirements of a water tanker to be used at the station. The second task is to conduct trade studies of system requirements, hardware/software, and operations to evaluate the effect of automatic operation at the station or remote from the station in consonance with the OMV. The last task is to evaluate automatic refueling concepts and to evaluate the impact to Orbital Spacecraft Consumable Resupply System (OSCRS) concept/design to use expendable launch vehicles (ELV) to place the tank into orbit. Progress in each area is discussed. B.G.

N88-11687*# Rockwell International Corp., Downey, Calif. Space Transportation Systems Div.
ORBITAL SPACECRAFT CONSUMABLES RESUPPLY SYSTEM (OSCRS). VOLUME 2: STUDY RESULTS Final Report
Mar. 1987 156 p
(Contract NAS9-17584)
(NASA-CR-172011; NAS 1.26:172011; STS-86-0302-2A-Vol-2; DRD-10-Vol-2; CDRL-MA-1023T-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 22A

The objective was to establish an earth storable fluids tanker concept which satisfies the initial resupply requirements for the Gamma Ray Observatory (GRO) for reasonable front end (design, development, verification) cost while providing growth potential for foreseeable future earth storable resupply mission requirements. The achievement of these objectives becomes possible with the development of a modularized tanker concept which is a hybrid of a dedicated GRO tanker and a generic earth storable propellant tanker. Author

N88-11712 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
SPACE MISSIONS TO COMETS HALLEY AND GIACOBINI-ZINNER [LES MISSIONS SPATIALES VERS LES COMETS DE HALLEY ET DE GIACOBINI-ZINNER]
Rejean Grard *In* CNES, Space Environment Technology Apr. 1987 p 261-286 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N88-11688# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
17 Jun. 1987 121 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-026) Avail: NTIS HC A06/MF A01

Topics addressed include: applied sciences; environmental quality; national developments; and physical sciences. For individual titles, see N88-11689 through N88-11692.

N88-11689# Joint Publications Research Service, Arlington, Va.
ANALYTICAL AVERAGE MODEL OF STUDIES ON ORBITAL RESONANCE Abstract Only
Xinhao Liao and Lin Liu *In its* JPRS Report: Science and Technology. China 17 Jun. 1987 p 36 Transl. into ENGLISH from Tianwen Xuebao (Beijing, Peoples Republic of China), v. 28, no. 1, Mar. 1987 p 11-24 (For primary document see N88-11688 03-13)
Avail: NTIS HC A06/MF A01

For a long time, from the aspect of gravitation, there are two mathematical models for studying orbital resonance: practical and averaged models. It is not convenient to use the practical model because it is devoid of simplifications in the dynamic systems discussed and fast variations are contained in the perturbation function. For this reason, most of the authors use the averaged model in which the perturbation function is averaged and the fast variations are cancelled. The averaged model is classified by numerical averaged and ideal resonant models, called Schubart's and Garfinkel's models respectively. Based on Schubart's model, the perturbation function of the system is expanded trigonmetrically in the mean anomaly of the perturbed and perturbing bodies. The secular and resonant terms are taken in the meaning of the first order. Therefore, the Hamiltonian of the resonant system, H sub L, was obtained as follows: H sub L = 1/2a + R sub c + R sub 1 + R sub r. H sub L is called the analytical averaged model. H sub L is discussed in detail and compared with Schubart's model and a practical model, respectively. It is seen that it is significant to establish H sub L and convenient for researching the characteristics and evolution of orbital resonance. Author

N88-11690# Joint Publications Research Service, Arlington, Va.
COMPUTATIONAL METHOD FOR ORBIT IMPROVEMENT FOR SHORT ARC OBSERVATIONS OF ARTIFICIAL SATELLITES Abstract Only
Yaying Liu *In its* JPRS Report: Science and Technology. China 17 Jun. 1987 p 37 Transl. into ENGLISH from Tianwen Xuebao (Beijing, Peoples Republic of China), v. 28, no. 1, Mar 1987 p 6-10 (For primary document see N88-11688 03-13)
Avail: NTIS HC A06/MF A01

According to the principle that the influence of atmospheric drag on the orbit perigee is far less than that on the eccentricity, a computational method for orbit improvement using the orbit perigee as the restraint condition is derived. It is of practical use in improving the accuracy of orbit determination by short arc visual observations, especially the accuracy of the orbit perigee. Author

N88-11691# Joint Publications Research Service, Arlington, Va.
ON AIR-DRAG PERTURBATION OF TRANSIT SATELLITE AND SELECTION OF PARAMETERS IN ORBIT IMPROVEMENT Abstract Only
Lianda Wu *In its* JPRS Report: Science and Technology. China 17 Jun. 1987 p 38 Transl. into ENGLISH of Tianwen Xuebao (Beijing, Peoples Republic of China), v. 28 no. 1, Mar. 1987 p 1-5 (For primary document see N88-11688 03-13)
Avail: NTIS HC A06/MF A01

The air-drag perturbation of a transit satellite is discussed in detail. It is shown that the perturbation of transit will display anomalies complicated in the period of maximum solar activity. Therefore, in precise orbit determination, great attention must be paid to it. In addition, how to select the air density model and parameters in the orbit determination is also discussed. Variations of the selected parameters with the arc length were studied. Author

N88-11692# Joint Publications Research Service, Arlington, Va.
HARD X-RAY TELESCOPE HAPI-1 AND ITS OBSERVATION OF CRAB PULSAR Abstract Only **c89**
Changjiang Dai *In its* JPRS Report: Science and Technology. China 17 Jun. 1987 p 39 Transl. into ENGLISH from Tianti Wuli Xuebao (Beijing, Peoples Republic of China), v. 7, no. 2, Apr. 1987 p 140-146 (For primary document see N88-11688 03-13)
Avail: NTIS HC A06/MF A01

A hard X-ray phoswich telescope, HAPI-1, is described that was designed to make observations of high flying balloons. The telescope is comprised of a 145 cm primary crystal of 5 mm thick CsI (T1) actively shielded over the lower 2 steradians by a 5 cm thick NaI (T1) crystal and has a field of view of approximately 4 deg HWHM determined by a graded shield and collimator. The scintillation pulses originating in CsI and NaI crystals are distinguished by pulse shape discrimination. All sub-systems of the telescope are described. The Crab pulsar was observed by HAPI-1 during a balloon flight on 23 May 1984, in the energy range of 20 to 200 KeV, and the observation results are presented. Author

N88-11713 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
SATELLITE ENVIRONMENT: POLAR ORBITS [ENVIRONMENT DU SATELLITE = ORBITES POLAIRES]
J. J. Berthelier and M. Blanc *In* CNES, Space Environment Technology Apr. 1987 p 287-329 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-11693# Ballistic Research Labs., Aberdeen Proving Ground, Md.
CURRENT-FILAMENTATION INSTABILITY IN RAILGUN ARCS
John D. Powell Jun. 1987 30 p
(AD-A184618; BRL-MR-3613) Avail: NTIS HC A03/MF A01 CSCL 20I

We extend some previous analysis of Rayleigh-Taylor instabilities in railgun arcs to treat the current-filamentation instability. The basic model is similar to that used in our previous treatment of the interchange instability, and the formalism is adapted from that developed by Tsai, Liskow, and Wilcox. It is demonstrated that railgun arcs are indeed unstable to the formation of current filaments for any nonzero value of the acceleration. However, numerical solution of the appropriate eigenvalue problem suggests that the growth rates of the unstable modes are generally too small, and the wavelengths generally too large, for the instability to be of much practical importance. GRA

N88-12147# Canada Centre for Remote Sensing, Ottawa (Ontario).
THE CANADIAN SPOT PROGRAM
R. A. ONeil *In* CNES, SPOT 1: First In-Flight Results 1987 p 33-40 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-11694# European Space Agency, Paris (France).
EMPIRICAL FORMULAS FOR THE BASE PRESSURE OF MISSILE BODIES WITH A CENTRAL PROPULSIVE JET
Mauri Tanner Jun. 1987 69 p Transl. into ENGLISH of Empirische Formeln fuer den Basisdruck von Flugkoerperruempfen mit Triebstrahl (Goettingen, Fed. Republic of Germany, DFVLR), Jun. 1986 Original language document was announced as N87-17816
(ESA-TT-1046; DFVLR-FB-86-38; ETN-87-90870) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 24

Empirical formulas for the prediction of the base pressure of missile bodies with a central propulsive jet are given. The formulas are valid at Mach numbers from 1.5 to 3.5. The jet exit diameter is DI/D = 0.60 and its Mach number MI = 2.5. For the cylindrical afterbody the influence of a larger jet exit diameter can be predicted. The exit plane divergence angle can be varied between 0 and 20 deg. ESA

N88-11695# European Space Agency, Paris (France).
BASE PRESSURE MEASUREMENTS ON A MISSILE BODY WITH CRUCIFORM TAIL
Mauri Tanner Jun. 1987 63 p Transl. into ENGLISH of Basisdruckmessungen an einem Flugkoerperrumpf mit Kreuzlettwerk (Goettingen, Fed. Republic of Germany, DFVLR), Oct. 1986 Original language document was announced as N87-26026
(ESA-TT-1062; DFVLR-FB-86-53; ETN-87-90877) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 21.50

Base pressure measurements were performed on an axisymmetric missile body having a cruciform tail, at Mach numbers between 0.5 and 1.0. The angle of incidence varied between 0 and 50 deg. The Reynolds number, related to the body diameter, was 340,000. The measurements were conducted in a transonic wind tunnel. The results show the influence of the tail on the base pressure, for three distances from the base. For large angles of incidence (greater than or = 15 deg) the base pressure depends on the roll angle of the cruciform tail. The effect of a base cavity on the base pressure of the body without tail was determined. ESA

N88-11696 Lehigh Univ., Bethlehem, Pa.
STABILITY OF MECHANICAL JOINTS IN LAUNCHING VEHICLES: LOCAL AND GLOBAL STATIONARY VALUES OF ENERGY DENSITY Ph.D. Thesis
Ching-Hwei Chue 1987 125 p
Avail: Univ. Microfilms Order No. DA8714661

A method was developed for predicting the behavior of mechanical joints in launch vehicles with particular emphasis placed on how the combined effects of loading, geometry, and materials could be optimized in terms of structure instability and/or integrity. What was considered to be essential is the fluctuation of the volume energy density with time in the structure. The peaks and valleys of the volume energy density function will be associated with failure by fracture and/or yielding while the distance between their local and global stationary values govern the structure instability. The Solid Rocket Booster (SRB) of the space shuttle was analyzed under axisymmetric and non-axisymmetric loadings. A semi-analytical finite element program was developed for solving the case of non-axisymmetric loading. Following a dynamic stress analysis, contours of the volume energy density in the structure were obtained as a function of time. The magnitudes and locations of these stationary values were then calculated locally and globally and related to possible failure by fracture. In the case of axisymmetric flight, the local and global instability behavior do not change appreciably. Fluctuations in the energy density and the dynamic stability length parameter become appreciable when the non-axisymmetric loads are considered. The magnitude of the energy in the shell structure is sensitive to alterations in the gas pressure induced by the solid propellant. Dissert. Abstr.

N88-11697# Lawrence Livermore National Lab., Calif.
THE IMPACT OF ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF MILLIMETER WAVE SEEKERS IN SMART MUNITIONS
R. Hager Aug. 1987 7 p
(Contract W-7405-eng-48)
(DE87-014277; UCID-21141) Avail: NTIS HC A02/MF A01

An assessment has been made of the degradation in performance of horizontal-glide smart munitions incorporating millimeter wave seekers operating in three types of environments. Atmospheric effects are shown to degrade performance appreciably only in very severe weather conditions. Electromagnetic line-of-sight masking due to foliage (forest canopy and tree-lined roads) will limit submunition usage and may be a potential problem. The most serious problem involves the confident detection of military vehicles in the presence of land clutter. Standard signal processing techniques involving signal amplitude and signal averaging are not likely to be adequate for detection. Observations regarding more sophisticated techniques and the current state of research are included. DOE

N88-11698# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FIN GAPS AND BODY SLOTS OF GUIDED PROJECTILES: EFFECTS, DATA CORRELATION AND MODELING
Ameer G. Mikhail Jun. 1987 51 p
(AD-A184440; BRL-TR-2808) Avail: NTIS HC A04/MF A01 CSCL 01A

Prior work concerned with the effect of streamwise fin-body gaps unporting effect and body slots on the fin loads of projectiles and missiles in the transonic speed regime of 0.8 less than or = M less than or = 1.2, was reviewed. Experimental data for the gap effects have been analyzed. A correlation established to predict fin normal force losses due to gaps for any fin shape, size, aspect ratio, fitted very well with the data which span a large variation in Reynolds number, body diameter and boundary layer thickness. Although the Mach range for the present model was intended to be 0.8 less than or = M less than or = 1.2, available data indicated its validity in the wider range of 0.7 less than or = M less than or = 1.6. Fifteen cases were used to validate the present gap model. Application of these two corrections to the Copperhead guided projectile was made and a reduction as large as 38% was predicted for the normal force, which was then validated by the experimental data. The present results can be used for estimating fin load losses for the fin design of guided projectiles and missiles, with 5% accuracy, over the intended Mach number range 0.8 less than or = M less than or = 1.2. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N88-11699*# Aerojet TechSystems Co., Sacramento, Calif.
CONFIGURATION EVALUATION AND CRITERIA PLAN. VOLUME 2: EVALUATION CRITERIA PLAN (UPDATE). SPACE TRANSPORTATION MAIN ENGINE (STME) CONFIGURATION STUDY
E. K. Bair Oct. 1987 31 p
(Contract NAS8-36867)
(NASA-CR-181429; NAS 1.26:181429; RPT/BB0323; DR-9)
Avail: NTIS HC A03/MF A01 CSCL 20H

Candidate main engine configurations which enhance vehicle performance, operation and cost are identified. These candidate configurations are evaluated and the configurations which provide significant advantages over existing systems are selected for consideration for the next generation of launch vehicles. The unbiased selection of the Space Transportation Main Engine (STME) configuration requires that the candidate engines be evaluated against a predetermined set of criteria which must be properly weighted to emphasize critical requirements defined prior to the actual evaluation. During a prior study of the STME a Gas Generator Cycle engine was selected for conceptual design, with emphasis on reusability, reliability and low cost while achieving good performance. In this study emphasis is on expendable application of the STME while maintaining low cost and high reliability. E.R.

N88-11700*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AEROASSISTED-VEHICLE DESIGN STUDIES FOR A MANNED MARS MISSION
Gene P. Menees Oct. 1987 16 p
(NASA-TM-100031; A-87356; NAS 1.15:100031) Avail: NTIS HC A03/MF A01 CSCL 22B

An aerobrake design that has matured over several years of development accounting for all of the important flow phenomenology which are characteristic of aerobraking vehicles is proposed as the mission baseline. Flight regimes and aerothermal environments for both Mars and Earth entry are calculated using advanced methods to account for real-gas, thermochemical, relaxation effects. The results are correlated with thermal-protection and structural requirements and mission performance capability. The importance of nonequilibrium radiative heating for Earth aerocapture is demonstrated. It is suggested that two aerobrakes of different sizes will produce optimal performance for the three phases of the mission (i.e., one aerobrake for Mars aerocapture and descent of the surface lander and another for Earth return). Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N88-11701# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung HF-Verfahren.
THE NAVIGATION EXPERIMENT NAVEX: EXPERIMENTAL RESULTS OF CLOCK SYNCHRONIZATION
Emil Sappl and Anita Zimmermann Jan. 1987 33 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1084)
(DFVLR-Mitt-87-05; ISSN-0176-7739; ETN-87-90591) Avail: NTIS HC A03/MF A01; DFVLR, Cologne, West Germany DM 12.50

Experimental results, gathered on Spacelab during the D1 mission are presented. The results were used to compare onboard time and time at the control station. The measuring values and their processing are explained. The processed measuring data are listed. The significance of the measurement results for the clock synchronization is discussed. ESA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-11702 Centre National d'Etudes Spatiales, Toulouse (France).
SPACE ENVIRONMENT TECHNOLOGY
Apr. 1987 751 p Partly in FRENCH and ENGLISH Lecture course presented in Toulouse, France, Apr. 1986
(ISBN-2-85428-170-5; ISSN-0766-1002; ETN-87-90631)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Lectures presented at the conference are presented. Areas of discussion are: Space plasma physics; the solar wind; and solar terrestrial interactions. Earth orbital environment, spacecraft charging and electrostatic discharges, and satellite design to overcome environmental effects were also discussed. For individual titles, see N88-11703 through N88-11734.

N88-11703 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
ELEMENTS OF PLASMA PHYSICS [ELEMENTS DE PHYSIQUE DES PLASMAS] **c75**
A. Saint-Marc and D. LeQueau *In* CNES, Space Environment Technology Apr. 1987 p 13-52 In FRENCH (For primary document see N88-11702 03-18)
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Individual and collective plasma processes are introduced. The Maxwell and Boltzmann equations are presented. Plasma frequency and cyclotron frequency are explained. The motion of individual charged particles is considered. The role of binary collisions and relaxation at thermodynamic equilibrium of a totally ionized plasma is discussed. Gain theory and the functioning of a Langmuir probe are mentioned. ESA

N88-11704 Observatoire du Pic-du-Midi, Bagneres de Bigorre (France).
THE SUN AND THE SOLAR ACTIVITY **c92**
J. L. Leroy *In* CNES, Space Environment Technology Apr. 1987 p 53-63 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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Observation of the solar atmosphere to study phenomena which can develop in the Sun's outer layers, strongly dependent on the solar magnetism, is introduced. Events like solar flares have a definite effect not only on large regions of the solar atmosphere but also on the neighboring interplanetary medium. Thus, the time variation of solar activity, with several time scales including the 11-yr cycle, is very important for the physics of the upper terrestrial atmosphere and magnetosphere. ESA

N88-11705 Observatoire de Paris-Meudon (France). Dept. de Recherche Spatiale.
THE SOLAR WIND **c92**
Jean-Louis Steinberg *In* CNES, Space Environment Technology Apr. 1987 p 65-71 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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The solar wind is a plasma emitted by the Sun which flows radially outward carrying the frozen-in magnetic field. Thus the magnetic lines of force take a spiral shape in the ecliptic. In a solar meridian plane a neutral sheet is formed near the equatorial plane which delineates a magnetic sector structure in the ecliptic. To fully understand solar wind structure, it is necessary to understand how a collisionless plasma can behave as a fluid obeying MHD laws. The solar wind carries several types of disturbance which influence our environment. It contains information

on the solar corona. It is the prototype of stellar winds which inject stellar matter into the interstellar medium, thus closing the universal cycle of matter. ESA

N88-11706 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
MORPHOLOGY OF THE EARTH'S ENVIRONMENT [MORPHOLOGIE DE L'ENVIRONMENT TERRESTRE] **c46**
H. Reme *In* CNES, Space Environment Technology Apr. 1987 p 73-100 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The environment of the Earth above 100 km altitude is described. The geomagnetic field; the neutral and ionized upper atmosphere; and the magnetosphere are discussed. ESA

N88-11707 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
RADIATION BELTS **c46**
R. Gendrin *In* CNES, Space Environment Technology Apr. 1987 p 101-124 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The constitution of the Earth's radiation belts is examined. Differential and integral flux, energy spectrum, angular distribution, spatial localization, and temporal variation are considered. In order to interpret the properties of these belts, the Stormer theory of the movement of energetic particles in an axisymmetric magnetic field is outlined. The competing mechanisms by which such particles are created, transported, and/or destroyed are discussed. ESA

N88-11708 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
IRRADIATIONS. ACCUMULATED DOSES. HEAVY IONS **c93**
Jacques Bourrieau *In* CNES, Space Environment Technology Apr. 1987 p 125-194 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The main characteristics of the space radiation environment (trapped p(+) and e(-), heavy ions, and p(+) from solar events, galactic cosmic rays) are reviewed. Interaction with matter, slowing down, stopping power, range, projected range, and methods used for the dose and shielding computation are described as well as characteristic results. Heavy ion effects (single event upset and latch-up), computation, and simulation methods and results are introduced. ESA

N88-11709 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
IONOSPHERE AND PLASMASPHERE [IONOSPHERE ET PLASMASPHERE] **c46**
J. C. Cerisier *In* CNES, Space Environment Technology Apr. 1987 p 195-208 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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The ionosphere is the cold plasma region due to the ionization of atmospheric particles, by solar UV photons. The electron concentration has a maximum value of 100,000 to 1 million/cc, at altitude = 300 km, which is the greatest plasma density in the Earth environment. Plasma diffusion along magnetic field lines can fill the inner magnetosphere with plasma from ionospheric origin. This torus-shaped plasma region is the plasmasphere. ESA

N88-11710 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
HOT PLASMAS IN THE EARTH'S MAGNETOSPHERE [PLASMAS CHAUDS DANS LA MAGNETOSPHERE TERRESTRE] **c75**
J. M. Bosqued *In* CNES, Space Environment Technology Apr. 1987 p 209-247 In FRENCH (For primary document see N88-11702 03-18)
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Satellite observations of the links between the solar wind, the magnetosphere and the ionosphere are reviewed. The properties of hot plasma (E (CH76) 50 keV) from external regions of energy transfer and injection to the dissipation region formed by the high latitude ionosphere are described. The plasma sheet, a reservoir of hot plasma which can reach geostationary orbit when the magnetosphere is perturbed, is described. Plasma morphology and particle motion in electric and magnetic fields are considered. It is shown that plasmas can be accelerated at low altitudes in intense auroral arcs. ESA

N88-11711 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
MAGNETOSPHERIC STORMS [LES ORAGES MAGNETOSPHERIQUES] **c46**
Jean-Andre Sauvaud *In* CNES, Space Environment Technology Apr. 1987 p 249-260 In FRENCH (For primary document see N88-11702 03-18)
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Magnetic storms are due to the growth of the solar wind-magnetosphere dynamo power. The storms and substorms correspond to periods of dissipation of this power within the magnetosphere by Joule heating, acceleration of charged particles, and electromagnetic emissions. ESA

N88-11712 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
SPACE MISSIONS TO COMETS HALLEY AND GIACOBINI-ZINNER [LES MISSIONS SPATIALES VERS LES COMETS DE HALLEY ET DE GIACOBINI-ZINNER] **c12**
Rejean Grard *In* CNES, Space Environment Technology Apr. 1987 p 261-286 In FRENCH (For primary document see N88-11702 03-18)
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The ESA, NASA, Soviet, and Japanese missions and spacecraft sent to comets Halley and Giacobini-Zinner are described. The ICE satellite flew past Giacobini-Zinner in September 1985. Suisei and Sakigake made optical and solar wind observations at 200,000 and 7 million km respectively from Halley's nucleus. The Vega 1 and 2 and Giotto probes photographed Halley, analyzed the dust and neutral gases around the nucleus, and studied the magnetic field, waves, and plasma along their trajectories. Vega 1 and 2 passed within 8890 and 8030 km of the nucleus respectively, Giotto came within 600 km. The data collected by the probes verify most model hypotheses formulated before the flights. ESA

N88-11713 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
SATELLITE ENVIRONMENT: POLAR ORBITS [ENVIRONMENT DU SATELLITE = ORBITES POLAIRES] **c13**
J. J. Berthelier and M. Blanc *In* CNES, Space Environment Technology Apr. 1987 p 287-329 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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The polar ionosphere and means to study it are described. The polar ionosphere, directly linked to the outer magnetosphere by the terrestrial magnetic lines of force, is subjected to the prevailing influence of the interaction between the solar wind and the Earth's magnetosphere. Unlike midlatitude, where only photoionization is present, ionization due to particle precipitation is important, even the major source during night and winter. The behavior of the ionosphere strongly depends on plasma transport. Instabilities generated by these two mechanisms result in a very inhomogeneous ionospheric plasma. ESA

N88-11714 Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.
HEAVY ELEMENT COMPOSITIONS AND ENERGY SPECTRA OF GALACTIC AND SOLAR COSMIC RAYS **c93**
J. J. Engelmann *In* CNES, Space Environment Technology Apr. 1987 p 331-351 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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The two components in the proton and heavy nuclei cosmic ray records: the galactic component, solar modulated in accordance with the 11 yr cycle; and the solar component, consisting of bursts of particles spread in interplanetary medium and occurring at random, but preferentially during the period of solar maximum, are discussed. Comparison of observed abundances of galactic cosmic rays and local galactic matter suggests that these sources originate in the high atmosphere of solar-like stars, spread throughout the Galaxy. As regard the solar proton events, observed abundances vary from one event to another. It is however possible to draw a basic composition, which, while different from local galactic and solar photospheric composition, is very similar to that observed in the solar corona and in galactic cosmic rays. Solar events were parameterized to evaluate their effects. There are typical spectra for the ordinary and anomalously large events, and there is a mean case and worst case composition of a typical event. ESA

N88-11715 Centre d'Etude Spatiale des Rayonnements, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.

SPACECRAFT SURFACE EXPOSURE TO ATOMIC OXYGEN IN LOW EARTH ORBIT

Alain Paillous *In* CNES, Space Environment Technology Apr. 1987 p 353-375 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)

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Flight experiments in the shuttle payload bay showing that interaction of oxygen atoms with surfaces can cause significant erosion of materials and components in low Earth orbits are discussed. Neutral atmospheric composition and its variations are described. Reaction efficiencies of various spacecraft surface materials are given. The fluences to which surfaces in typical orbits are exposed are estimated. The problems of the simulation techniques to be used in laboratory are considered. ESA

N88-11716* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE GEOSYNCHRONOUS PLASMA ENVIRONMENT

Henry Berry Garrett *In* CNES, Space Environment Technology Apr. 1987 p 377-411 (For primary document see N88-11702 03-18)

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The geosynchronous plasma environment in the 0 to 100 keV energy range as input in the modeling of spacecraft charging phenomena is summarized. Models for spacecraft design are reviewed, emphasizing practical tools for predicting the effects of spacecraft interactions on satellite systems. ESA

N88-11717 Centre National d'Etudes Spatiales, Toulouse (France).

INTRODUCTION TO THE PROBLEM OF ENVIRONMENTALLY INDUCED DISCHARGES

Jean-Pierre Catani *In its* Space Environment Technology Apr. 1987 p 413-428 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)

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The history of research into electrostatic discharges on geosynchronous satellites is reviewed. Models used to simulate the phenomenon, and the weaknesses of these models when confronted with flight data are discussed. Design rules resulting from the refinement of predictive models are introduced. ESA

N88-11718 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).

A SIMPLIFIED APPROACH TO THE DYNAMICS OF CHARGED PARTICLES IN THE MAGNETOSPHERE **c46**

Michel Blanc *In* CNES, Space Environment Technology Apr. 1987 p 429-439 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)

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The open magnetosphere model is used to describe qualitatively the main features of the transport of cold and hot charged particles in the magnetosphere, and of the spatial distribution of these paticles which results from this transport. The resulting distribution of these particles at the geostationary orbit is emphasized. ESA

N88-11719 Centre d'Etude Spatiale des Rayonnements, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.

EXTERNAL SURFACE CHARGING MECHANISMS

Leon Levy *In* CNES, Space Environment Technology Apr. 1987 p 441-457 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)

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Absolute and differential charging on geosynchronous satellites is introduced. It is the consequence of particle injection associated with substorm development. The importance of conductivity and secondary emission for the behavior of electron bombarded dielectrics is emphasized. An environment worst-case depending on material properties is discussed. ESA

N88-11720* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THREE-DIMENSIONAL CHARGING EFFECTS

Henry Berry Garrett *In* CNES, Space Environment Technology Apr. 1987 p 459-495 (For primary document see N88-11702 03-18)

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The physics of three dimensional spacecraft charging is reviewed. The asymmetric plasma sheath created around a spacecraft can significantly alter the trajectories of incoming particles or repel secondary particles emitted from the surface back to the surface. Thus seemingly anomolous potential variations can be encountered. Depending on the sensitivities of the spacecraft and its instruments to such variations, charging can jeopardize mission performance or even mission life through enhanced arcing. Three dimensional interactions between the Space Station and the ambient plasma and magnetic field are increasingly important. ESA

N88-11721 TRW Defense and Space Systems Group, Redondo Beach, Calif.

MODELING OF ENVIRONMENTALLY-INDUCED EFFECTS WITHIN SATELLITES. PART 1: NASCAP MODELING OF SATELLITES

N. John Stevens *In* CNES, Space Environment Technology Apr. 1987 p 497-510 (For primary document see N88-11702 03-18)

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The use of the NASCAP computer code to predict the charging of spacecraft surfaces in response to geomagnetic substorm environments is treated. Spacecraft models corresponding to a spin and three-axis stabilized satellite are discussed. The models are run primarily to determine the charge storage in the dielectrics and to locate the possible sites for discharges. The possibility of utilizing expanded NASCAP models to view potential profiles in more detail is illustrated. ESA

N88-11722 TRW Defense and Space Systems Group, Redondo Beach, Calif.

MODELING OF ENVIRONMENTALLY-INDUCED TRANSIENTS WITHIN SATELLITES. PART 2: DISCHARGE COUPLING TRANSIENTS

N. John Stevens *In* CNES, Space Environment Technology Apr. 1987 p 511-521 (For primary document see N88-11702 03-18)

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The discharge process and means of computing the coupling from an exterior discharge into a spacecraft electrical system are discussed. Coupling is assumed to be the result of structure current magnetic field linkages with the electrical harness. Lumped element modeling descriptions of the structure and cables can be used and the network solved using the SPICE computer code. A simplified model of a spin-stabilized spacecraft transient is used to illustrate the technique. ESA

N88-11723 Centre d'Etude Spatiale des Rayonnements, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.
DISCHARGE PHENOMENA
Leon Levy *In* CNES, Space Environment Technology Apr. 1987 p 523-543 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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The different ways of discharging likely to occur on satellite external surfaces are divided into two large categories: dielectric and metallic discharges. For each category, breakdown criteria are indicated. ESA

N88-11724 Centre National d'Etudes Spatiales, Toulouse (France).
IN-FLIGHT DIAGNOSIS: ANALYSIS OF SPURIOUS EVENTS
Jean-Pierre Catani *In its* Space Environment Technology Apr. 1987 p 545-559 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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Analysis methods to identify the origin or the location on the spacecraft of environmentally induced discharges generating spurious events are described. It is shown how configuration, geomagnetic activity, and orbital position are related to discharge hazards. ESA

N88-11725 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ELECTROMAGNETIC INTERACTION BETWEEN AN ELECTRIC DISCHARGE AND CABLING INSIDE A SATELLITE [INTERACTION ELECTROMAGNETIQUE ENTRE LE RAYONNEMENT D'UNE DECHARGE ELECTRIQUE ET DES CABLAGES SITUES A L'INTERIEUR D'UN SATELLITE]
J. C. Alliot *In* CNES, Space Environment Technology Apr. 1987 p 561-587 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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Electric discharge in a satellite, with and without spatial extension, is modeled as a dipole. It is shown that the interaction process between the electromagnetic fields of the dipole and the internal electrical wiring may be separated into three phases. In an external interaction process, the electromagnetic fields of the discharge cause electrical charges to flow on the external surface of the vehicle. In an internal interaction process, energy penetrates through the shell of the vehicle. In an internal energy propagation, the energy propagates along cabling which forms transmission lines and disturbs electronic boxes which can be temporarily upset or permanently damaged. Each process is analyzed by analytical methods and numerical examples are given. ESA

N88-11726 Centre National d'Etudes Spatiales, Toulouse (France).
ELECTROMAGNETIC EFFECTS OF A DISCHARGE ON CIRCUITRY
Jean-Pierre Catani *In its* Space Environment Technology Apr. 1987 p 589-611 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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Effects of interference due to electromagnetic discharges on spacecraft are analyzed as the composition of a common mode noise and a serial mode noise. Characteristic parameters to qualify the ability of circuitry in rejection of common mode noise are defined. Star-grounding and multigrounding concepts are evaluated using this parameter. ESA

N88-11727 Intespace, Toulouse (France).
IRRADIATION TESTING [ESSAIS D'IRRADIATION] **c32**
G. Boures *In* CNES, Space Environment Technology Apr. 1987 p 613-630 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France
Space environment simulation to study the effects of electromagnetic interference generated electrostatic disharges on satellite equipment is introduced. The electron beam source, vacuum and temperature control apparatus, and the solar simulator are described. Tests on a Meteosat prototype and on satellite subsystems are outlined. ESA

N88-11728 MATRA Espace, Toulouse (France).
CHARGING CALCULATIONS FOR THE HIPPARCOS SATELLITE
Michel Frelet *In* CNES, Space Environment Technology Apr. 1987 p 631-650 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France
Electrostatic charging of the HIPPARCOS satellite was simulated using the ESABASE/CHARGING software. It is based on the NASCAP program and its auxiliary codes. The NASCAP material properties were computed starting from measurements, thus the numerical results are more reliable. The simulation results show that the satellite configuration is clean with respect to electrostatic charging. ESA

N88-11729 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
MARECS-A CASE
H. G. Lechte *In* CNES, Space Environment Technology Apr. 1987 p 651-661 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France
Anomalies observed in the MARECS-A power and attitude control subsystem are recalled, and investigations and improvements prompted by them are summarized. It is suggested that MARECS-A failures are due to electric discharges damaging semiconductors. Extensive use of anticharging and antistatic materials, particularly for solar arrays, is recommended. It is necessary to improve the design of electronic circuits to provide sufficient transient immunity. The main source for interference by discharge transients is the short response time of memories or actuators, combined with the sensitivity to voltage transients between common return lines for power or signals. In applications vulnerable to possible upsets of the spacecraft operation it is necessary to provide for sufficient transient immunity. ESA

N88-11730 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ENVIRONMENTAL INTERACTIONS OF SOLAR GENERATORS IN SPACE **c90**
K. Bogus *In* CNES, Space Environment Technology Apr. 1987 p 663-679 (For primary document see N88-11702 03-18)
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The effects on deployable solar generators of Sun/eclipse thermal cycles, low Earth orbit plasma, atomic oxygen, ultraviolet radiation and particles, the residual atmosphere, micrometeorites, and magnetic substrorms are reviewed. Space environment simulation test results are discussed. ESA

N88-11731 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ELECTROMAGNETIC COMPATIBILITY (EMC) PHENOMENA AND PREVENTION OF THE EFFECTS **c32**
L. Inzoli *In* CNES, Space Environment Technology Apr. 1987 p 681-693 (For primary document see N88-11702 03-18)
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The electromagnetic compatibility analysis of electrostatic discharge effects on spacecraft is introduced. The characterization of the transient noise source, the coupling paths to susceptible circuits, the effects on the electronic circuit and their hardening, and test set-ups are described. The order of magnitude of the parameters involved for each step is indicated. ESA

N88-11732 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
DISCHARGE PREVENTION OF GEOSYNCHRONOUS ORBIT CONDUCTIVE THERMAL CONTROL MATERIALS AND GROUNDING SYSTEMS

F. Levadou *In* CNES, Space Environment Technology Apr. 1987 p 695-715 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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Research on the prevention of discharges in geosynchronous orbit for telecommunications and scientific satellites is summarized. Materials properties characterization, electrostatic discharge tests, grounding system development, and evaluation of materials and processes are discussed. ESA

N88-11733 MATRA Espace, Toulouse (France).
ELECTROSTATIC DISCHARGES IN GEOSTATIONARY ORBIT: THE CASE OF TELECOM 1 [DECHARGES ELECTROSTATIQUES EN ORBITE GEOSTATIONNAIRE. LE CAS DE TELECOM 1]
M. Garreau *In* CNES, Space Environment Technology Apr. 1987 p 717-733 In FRENCH (For primary document see N88-11702 03-18)
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The precautions implemented in the design, manufacturing, and test phases of the Arabsat spacecraft to avoid problems caused by the geostationary environment are described. The experience of the first year in orbit of the two launched models shows that the precautions have the desired effects. ESA

N88-11734 Societe Nationale Industrielle Aerospatiale, Cannes (France).
PREVENTION OF RADIATION INDUCED DEGRADATIONS AND OF ELECTROSTATIC PERTURBATIONS ON THE ARABSAT SPACECRAFT IN FLIGHT RESULTS
L. Broihanne *In* CNES, Space Environment Technology Apr. 1987 p 735-751 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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Anomalies observed on Telecom 1 equipment in orbit were investigated by subjecting Telecom 1B to electrostatic discharges, in the laboratory. Results confirm that the anomalies are due to the discharges, which are caused by the interaction of metallic components, electronic equipment outside the main satellite shell, peripheral cabling, and equipment sensitive to rapid transients outside test specifications. Design rules to overcome this situation are given. ESA

N88-11735* Control Research Corp., Lexington, Mass.
CONTROL DESIGN CHALLENGES OF LARGE SPACE SYSTEMS AND SPACECRAFT CONTROL LABORATORY EXPERIMENT (SCOLE) Final Report
Jiguan Gene Lin Oct. 1987 71 p
(Contract NAS1-18185)
(NASA-CR-178392; NAS 1.26:178392) Avail: NTIS HC A04/MF A01 CSCL 22B

The quick suppression of the structural vibrations excited by bang-bang (BB) type time-optional slew maneuvers via modal-dashpot design of velocity output feedback control was investigated. Simulation studies were conducted, and modal dashpots were designed for the SCOLE flexible body dynamics. A two-stage approach was proposed for rapid slewing and precision pointing/retargeting of large, flexible space systems: (1) slew the whole system like a rigid body in a minimum time under specified limits on the control moments and forces, and (2) damp out the excited structural vibrations afterwards. This approach was found promising. High-power modal/dashpots can suppress very large vibrations, and can add a desirable amount of active damping to modeled modes. Unmodeled modes can also receive some concomitant active damping, as a benefit of spillover. Results also show that not all BB type rapid pointing maneuvers will excite large structural vibrations. When properly selected small forces (e.g., vernier thrusters) are used to complete the specified slew maneuver in the shortest time, even BB-type maneuvers will excite only small vibrations (e.g., 0.3 ft peak deflection for a 130 ft beam). Author

N88-11736*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
AEROASSISTED MANNED TRANSFER VEHICLE (TAXI) FOR ADVANCED MARS TRANSPORTATION: NASA/USRA 1987 SENIOR DESIGN PROJECT
1987 245 p Sponsored by NASA, Washington, D.C. and Universities Space Research Association
(NASA-CR-181478; NAS 1.26:181478) Avail: NTIS HC A11/MF A01 CSCL 22B

A conceptual design study of an aeroassisted orbital transfer vehicle is discussed. Nicknamed TAXI, it will ferry personnel and cargo: (1) between low Earth orbit and a spacecraft circling around the Sun in permanent orbit intersecting gravitational fields of Earth and Mars, and (2) between the cycling spacecraft and a Mars orbiting station, co-orbiting with Phobos. Crew safety and mission flexibility (in terms of ability to provide a wide range of delta-V) were given high priority. Three versions were considered, using the same overall configuration based on a low L/D aerobrake with the geometry of a raked off elliptical cone with ellipsoidal nose and a toroidal skirt. The propulsion system consists of three gimballed LOX/LH2 engines firing away from the aerobrake. The versions differ mainly in the size of the aeroshields and propellant tanks. TAXI A version resulted from an initial effort to design a single transfer vehicle able to meet all delta-V requirements during the 15-year period (2025 to 2040) of Mars mission operations. TAXI B is designed to function with the cycling spacecraft moving in a simplified, nominal trajectory. On Mars missions, TAXI B would be able to meet the requirements of all the missions with a relative approach velocity near Mars of less than 9.3 km/sec. Finally, TAXI C is a revision of TAXI A, a transfer vehicle designed for missions with a relative velocity near Mars larger than 9.3 km/sec. All versions carry a crew of 9 (11 with modifications) and a cargo of 10000 lbm. Trip duration varies from 1 day for transfer from LEO to the cycling ship to nearly 5 days for transfer from the ship to the Phobos orbit. Author

N88-11737*# Ball Aerospace Systems Div., Boulder, Colo.
ELECTRODYNAMIC TETHER SYSTEM STUDY Final Report
Sep. 1987 75 p
(Contract NAS9-17666)
(NASA-CR-172024; NAS 1.26:172024) Avail: NTIS HC A04/MF A01 CSCL 22B

The purpose of this program is to define an Electrodynamic Tether System (ETS) that could be erected from the space station and/or platforms to function as an energy storage device. A schematic representation of the ETS concept mounted on the space station is presented. In addition to the hardware design and configuration efforts, studies are also documented involving simulations of the Earth's magnetic fields and the effects this has on overall system efficiency calculations. Also discussed are some preliminary computer simulations of orbit perturbations caused by the cyclic/night operations of the ETS. System cost estimates, an outline for future development testing for the ETS system, and conclusions and recommendations are also provided. B.G.

N88-11738# Sandia National Labs., Albuquerque, N. Mex.
ESTIMATING PAYLOAD INTERNAL TEMPERATURES AND RADIATOR SIZE FOR MULTIMEGAWATT SPACE PLATFORMS
Dean Dobranich Aug. 1987 74 p
(Contract DE-AC04-76DP-00789)
(DE88-000244; SAND-87-1216) Avail: NTIS HC A04/MF A01

A conceptual space platform consists of a payload, a power conditioning unit (PCU), and two radiators: the main radiator and a secondary radiator. A computer program was written to determine the required size of the two radiators and the temperatures of the PCU and payload for a given platform power level. An iterative approach is necessary because the required size of the main radiator depends on the size of the secondary radiator and vice versa. Also, the temperatures of the payload and PCU depend on the size of the radiators. The program user can subdivide the two radiators into any number of nodes to increase the accuracy of the radiant heat transfer solution. The use of more nodes also allows better prediction of the nonlinear temperature drop that

occurs across the radiators as the working fluid deposits the platform's waste heat in the radiator. View factor expressions are automatically calculated for different choices of the number of nodes. The user can also select different separation distances between the various platform structures. A model is included to couple the radiant and conduction heat transfer that occurs between the payload and its meteoroid shell and between the PCU and its shell. DOE

N88-11739# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
CONSIDERATIONS CONCERNING A THERMAL JOINT FOR A DEPLOYABLE OR STEERABLE BATTERY RADIATOR FOR THE COLUMBUS POLAR PLATFORM
A. A. M. Delil 6 Jun. 1986 41 p Sponsored in part by Fokker B.V.
(NLR-TR-86055-U; B8709830; ETN-87-91331) Avail: NTIS HC A03/MF A01

Concepts for a moveable thermal joint are discussed with respect to the applicability in a dedicated deployable or steerable heat pipe radiator system to handle the waste heat of the NiH batteries of the Polar Platform. Possible candidates for near-term deployable radiator development are: the flexible heat pipe; the low-melting-point alloy filled, grease filled, or low pressure helium gas filled (finned) heat exchanger; the braided conductor (having high mass and retraction torque); and the clamped contact. The flexible heat pipe is less attractive for steerable radiator applications. The braided conductor and the clamped contact are inadequate. The nonsolid material filled heat exchanger is the preferable joint if steerability is required. ESA

N88-11740# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
ADAPTIVE CONTROL OF LARGE SPACE STRUCTURE (LSS)
Yu Shaohua Mar. 1987 43 p
(ISAS-R-621; ISSN-0285-6808) Avail: NTIS HC A03/MF A01

A set of closely related topics concerning the methodology of an optimal attitude maneuver control of a satellite with flexible appendages is investigated, i.e., such as a mathematical model of coupled motion, pulse-mode control, optimal and programmed maneuvers, appendage vibration damping through adaptive control and conventional control, and an adaptive identification (deterministic and stochastic) algorithm of time-varying modal coordinate parameters. A distinctive feature of the research was that only the actuators of the central satellite attitude control system were assumed to perform both satellite attitude control and appendage deformation control. Some aspects of interaction between control system characteristics and structure/configuration design parameters are outlined. Author

N88-11741*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL SPACECRAFT CONSUMABLES RESUPPLY SYSTEM (OSCRS): MONOPROPELLANT APPLICATION TO SPACE STATION AND OMV AUTOMATIC REFUELING IMPACTS OF AN ELV LAUNCH, VOLUME 4 Final Report
Sep. 1987 133 p
(Contract NAS9-17585)
(NASA-CR-172029; NAS 1.26:172029; MCR-87-1339-Vol-4; DRD-10-Vol-4) Avail: NTIS HC A07/MF A01 CSCL 22B

The use of orbital spacecraft consumables resupply system (OSCRS) at the Space Station is investigated, its use with the orbital maneuvering vehicle, and launch of the OSCRS on an expendable launch vehicles. A system requirements evaluation was performed initially to identify any unique requirements that would impact the design of OSCRS when used at the Space Station. Space Station documents were reviewed to establish requirements and to identify interfaces between the OSCRS, Shuttle, and Space Station, especially the Servicing Facility. The interfaces between OSCRS and the Shuttle consists of an avionics interface for command and control and a structural interface for launch support and for grappling with the Shuttle Remote Manipulator System. For use of the OSCRS at the Space Station, three configurations were evaluated using the results of the interface definition to increase the efficiency of OSCRS and to decrease the launch weight by Station-basing specific OSCRS subsystems. A modular OSCRS was developed in which the major subsystems were Station-based where possible. The configuration of an OSCRS was defined for transport of water to the Space Station. Author

N88-11742# Naval Postgraduate School, Monterey, Calif.
AN EXAMINATION OF THE ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS) AND ITS APPLICATION TO THE DEFENSE DATA NETWORK (DDN) M.S. Thesis
Stephen C. Horner Jun. 1987 93 p
(AD-A184003) Avail: NTIS HC A05/MF A01 CSCL 22B

This thesis examines NASA's Advanced Communications Technology Satellite (ACTS) with emphasis on its potential applicability to the Defense Data Network (DDN). The ACTS program is a joint NASA industry program to develop the next generation of communications satellites, thus assuring the U.S.'s continued pre-eminence in this area. The ACTS will essentially operate as a switchboard in the sky. The thrust of the thesis is to take a broad-brush look at the system and discuss its applicability to DoD's packet switching data network, the DDN. This thesis is written so that a technical background is not required by the reader. Applicable background information is provided where necessary. The emphasis is on the concepts involved and a discussion of the interoperability of the two systems. GRA

N88-12022# Kyushu Univ., Fukuoka (Japan). Dept. of Aeronautical Engineering.
ON THE ROOT LOCUS METHOD APPLIED TO FLEXURAL VIBRATION CONTROL SYSTEMS
Norihiro Goto and Shinji Hokamoto *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 187-200 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

N88-12133# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Directorate of Earth Observation and Microgravity.
PAYLOAD CONFIGURATIONS AND SERVICEABILITY
N. deVilliers *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 11-16 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

N88-12134# European Space Agency, Paris (France). Directorate of Telecommunications Programs.
INTEROPERABILITY AND INTEGRATION OF DATA RELAY SATELLITE SYSTEMS
G. Barretta *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 17-25 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

N88-12178# Centre National d'Etudes Spatiales, Toulouse (France). Sous-Direction Applications.
THE NEW GENERATION OF SPOT SATELLITES [LA NOUVELLE GENERATION DES SATELLITES SPOT]
Michel Courtois *In its* SPOT 1: First In-Flight Results 1987 p 287-291 In FRENCH (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N88-11743# National Geodetic Survey, Rockville, Md.
GEOSAT ALTIMETER GEOPHYSICAL DATA RECORD USER HANDBOOK
R. E. Cheney, B. C. Douglas, R. W. Agreen, L. Miller, and D. L.

Porter Jul. 1987 35 p
(PB87-213336; NOAA-TM-NOS-NGS-46) Avail: NTIS HC A03/MF A01 CSCL 14B

In March 1985, the U.S. Navy altimeter satellite GEOSAT began generating a data set with unprecedented spatial and temporal coverage of the global oceans. The satellite carries a radar altimeter that provides a profile of sea level along the satellite ground track. Such records enable determination of sea level and its variability, and have application in many areas of geodesy and ocean dynamics. As suggested by the acronym GEOSAT, the satellite's primary purpose was improvement of the marine gravity field. Because of the value of this information to the U.S. military, the first 18 months of observations are classified. However, the geodetic mission ended September 30, 1986, and on October 1, a series of maneuvers was begun to alter the orbit to produce sea surface profiles within a few kilometers of previous released SEASAT data tracks. This orbit has a repeat period of about 17 days, and the mission is now referred to as the GEOSAT Exact Repeat Mission (ERM). The ERM officially became operational November 8, 1986. The contents of the report include the following: the GEOSAT altimeter mission; geophysical data records (ocean); geophysical data records (land and ice); and data analysis considerations. GRA

N88-11744 Arizona Univ., Tucson.
THE ABSOLUTE RADIOMETRIC CALIBRATION OF SPACE-BASED SENSORS Ph.D. Thesis
Ronald Gene Holm 1987 191 p
Avail: Univ. Microfilms Order No. DA8715714

A reflectance based inflight calibration procedure is used to determine the radiance reaching the entrance pupil of a sensor. This procedure uses ground based measurements coupled with a radiative transfer code to characterize the effects the atmosphere has on the signal reaching the sensor. The computed radiance is compared to the digital count output of the sensor associated with the image of a test site. This provides an update to the preflight calibration of the system and a check on the on-board internal calibrator. This calibration procedure was used to perform a series of 5 calibrations of the LANDSAT-5 Thematic Mapper. The absolute calibration techniques were put to another test with a series of 3 calibration of the SPOT-1 High Resolution Visible sensors. The procedure for performing a satellite calibration was then used to demonstrate how a calibrated satellite sensor can be used to quantitatively evaluate surface reflectance over a wide range of surface features. Predicted reflectance factors were compared to values obtained from aircraft based radiometer data. A strong correlation was shown between reflectance values determined from satellite imagery and low flying aircraft data.
Dissert. Abstr.

N88-12152# Centre d'Etudes et de Recherches, Toulouse (France).
ABSOLUTE AND INTERBAND CALIBRATION [ETALONNAGE ABSOLU ET INTERBANDE]
Magdeleine Dinguirard *In* CNES, SPOT 1: First In-Flight Results 1987 p 71-78 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-11745*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC POWER MODULES FOR NASA'S MANNED SPACE STATION
Charles A. Tatro [1987] 13 p Proposed for presentation at the 1988 Solar Energy Conference, Golden, Colo., 10-14 Apr. 1988; sponsored by ASME
(NASA-TM-100229; E-3850; NAS 1.15:100229) Avail: NTIS HC A03/MF A01 CSCL 10C

The capability and the safety of manned spacecraft are largely dependent upon reliable electric power systems. Two similar space power systems able to survive the low Earth orbit environment, are being considered for NASA's Manned Space Station (SS), scheduled to begin operation in the mid 1990's. The Space Station Electric Power System (EPS) is composed of Photovoltaic (PV) Power Modules, Solar Dynamic (SD) Power Modules, and the Power Management and Distribution (PMAD) System. One EPS configuration will deliver 37.5 kW of PV based, utility grade, ac power to SS users. A second 75 kWe PV based EPS option is also being considered for SS deployment. The two EPS options utilize common modules and differ only in the total number of PV Power Modules used. Each PV Power Module supplies 18.75 kWe of ac power and incorporates its own energy storage and thermal control. The general requirements and the current preliminary design configuration of the Space Station PV Power Modules are examined. Author

N88-11746*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE STATION PROPULSION
Robert E. Jones, W. Earl Morren, James S. Sovey, and Robert R. Tacina [1987] 19 p Presented at the 1987 JANNAF Propulsion Conference, San Diego, Calif., 15-17 Dec. 1987
(NASA-TM-100216; E-3825; NAS 1.15:100216) Avail: NTIS HC A03/MF A01 CSCL 21H

Two propulsion systems have been selected for the space station: gaseous H/O rockets for high thrust applications and the multipropellant resistojets for low thrust needs. These two thruster systems integrate very well with the fluid systems on the space station, utilizing waste fluids as their source of propellant. The H/O rocket will be fueled by electrolyzed water and the resistojets will use waste gases collected from the environmental control system and the various laboratories. The results are presented of experimental efforts with H/O and resistojet thrusters to determine their performance and life capability, as well as results of studies to determine the availability of water and waste gases. Author

N88-11747*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPRE 1 FREE-PISTON STIRLING ENGINE TESTING AT NASA LEWIS RESEARCH CENTER
James E. Cairelli [1977] 15 p Proposed for presentation at the 1988 Solar Energy Conference, Golden, Colo., 10-14 Apr. 1988; sponsored by ASME
(NASA-TM-100241; E-3865; NAS 1.15:100241) Avail: NTIS HC A03/MF A01 CSCL 10B

As part of the NASA funded portion of the SP-100 Advanced Technology Program the Space Power Research Engine (SPRE 1) was designed and built to serve as a research tool for evaluation and development of advanced Stirling engine concepts. The SPRE 1 is designed to produce 12.5 kW electrical power when operated with helium at 15 MPa and with an absolute temperature ratio of two. The engine is now under test in a new test facility which

was designed and built at NASA Lewis specifically to test the SPRE 1. The SPRE 1, the NASA test facility, the initial SPRE 1 test results, and future SPRE 1 test plans are described. Author

N88-11748*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A LOW-POWER ARCJET CYCLIC LIFETEST
Francis M. Curran, Terry L. Hardy, and Thomas W. Haag 1987 15 p Presented at the 1987 JANNAF Propulsion Conference, San Diego, Calif., 15-17 Dec. 1987
(NASA-TM-100233; E-3858; NAS 1.15:100233) Avail: NTIS HC A03/MF A01 CSCL 21H

A cyclic lifetest of a low power dc arcjet thruster using a hydrogen/nitrogen propellant mixture simulating hydrazine is currently in progress. Over 300 hr of operation have been accumulated to date in 2 hr duty cycles at a power level of about 1.15 kW, approximating that available on commercial communications satellites. A burn-in period was carried out before consistent operation was attained. After this period, the arcjet operated in a very stable fashion from cycle to cycle. At the beginning of each cycle, there was a brief starting transient followed by a rapid rise to a steady-state voltage. The steady-state voltage increased by about 5 V over the first 95 cycles. After this, it increased by only 1 V through the remainder of the test. Thrust measurements taken before the life test and again after the completion of the 144th cycle showed that both thrust, specific impulse, and arc voltage had increased over this period of operation. No life limiting mechanisms were observed during the course of the testing. Author

N88-11749*# Page (R. J.) Co., Santa Ana, Calif.
SLIP CASTING AND EXTRUDING SHAPES OF RHEMIUM WITH METAL OXIDE ADDITIVES. PART 2: DEVELOPMENT OF GRAIN STABILIZED RHENIUM PARTS FOR RESISTOJETS Final Report
Francis A. Barr and Russell J. Page Nov. 1987 22 p
(Contract NAS3-24651)
(NASA-CR-180851; NAS 1.26:180851) Avail: NTIS HC A03/MF A01 CSCL 21H

The adaptation of the powdered particle process used for pure metal oxides to the coprocessing of rhenium oxides suitable to produce pure miniature resistojet hardware has been successful. Both slip casting and extrusion processes were used. The metal oxide ZrO_2 was stabilized into the cubic phase with Y_2O_3, for use as a potentially grain stabilizing additive to rhenium. Straight meter long tubing in two sizes are reported. Tubing suitable for resistojet ohmic heater use of fully fired dimensions of nominally 3.8 mm o.d. x 2.2 mm i.d.. and 1.26 mm o.d. x .45 mm i.d. with 0, 0.5, 1.0 and 5.0% zirconia additives were produced for further study. Photomicrographs of these are discussed. The addition of the metal oxide zirconia to rhenium resulted in more dense and less porous parts. The additions of phase stabilized zirconia most likely act as a sintering aid. Tubes of varying diameter were slip cast which were representative of miniature pressure cases. Author

N88-11750*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A LIFE TEST OF A 22-NEWTON (5-lbf) HYDRAZINE ROCKET
P. R. Meng, S. J. Schneider, C. J. Morgan, R. E. Jones, and D. A. Pahl (Rocket Research Corp., Redmond, Wash.) [1987] 12 p Prepared for presentation at the JANNAF Propulsion Conference, San Diego, Calif., 15-17 Dec. 1987
(NASA-TM-100232; E-3857; NAS 1.15:100232) Avail: NTIS HC A03/MF A01 CSCL 21H

Life tests were conducted on a 22-N (5-lb) hydrazine rocket thruster which incorporates the latest technology to obtain long life from the catalyst bed. A spring mechanism surrounding the catalyst bed continually applies compression to the catalyst bed to prevent the formation of any void channels. The research rocket thruster was tested over an operational cycle of both steady state and pulse firing which simulated a possible space station duty cycle. The thruster ran as expected for about 40 hours, or 3.2 times 10 to the 6th power N-sec (7.2 times 10 to the 5th power lb-sec) total impulse. Subsequently, some thrust chamber pressure decreases were noted during long steady state test periods. After 60.2 hours of run time, tests had to be terminated due to a blockage in the propellant injector tube which occurred during heating of the thruster by a heat lamp. A chemical analysis of the catalyst indicated that iron and nickel metals had poisoned some of the catalyst, thereby causing a degradation in performance. It was determined that a contaminated barrel of hydrazine was the source of the metal poisoning. Author

N88-11751# Committee on Science, Space and Technology (U.S. House).
RESULTS OF THE DEVELOPMENT MOTOR 8 TEST FIRING
Washington GPO 1987 72 p Hearing before the Subcommittee on Space Science and Applications of the Committee on Science, Space and Technology, 100th Congress, 1st Session, 16 Sep. 1987
(GPO-78-692) Avail: Subcommittee on Space Science and Applications

The testimony of the NASA Associate Administrator for the Office of Space Flight and technical assistants before the subcommittee is presented. The August 1987 test firing of Development Motor 8 of the Solid Rocket Motor of the Space Transportation System was a milestone in resumption of Space Shuttle flights. The performance of O ring seals is emphasized. J.P.B.

N88-11752# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
DESTRUCTION TEST OF SMALL SCALED SOLID PROPELLANT MOTORS
Motoki Hinada, Ryojiro Akiba, Teruo Kishi, Yasunori Matogawa, and Shigeki Tsukamoto Nov. 1986 24 p
(ISAS-R-620; ISSN-0285-6808) Avail: NTIS HC A03/MF A01

Destruction ground tests have been carried out using three scaled down solid propellant motors using pairs of V-shaped charges. Each motor is a one/tenth scale model of the first stage of the Mu-3C, an all solid propellant satellite launcher developed by ISAS. Destruction devices in these tests are roughly the same in function and installation as those for the Mu-3C. Several interesting results have been obtained on the breakup characteristics of the motor, such as mode of destruction, shapes of fragments of propellant and hardware, scattering distribution, the shock load undergone by the motor and the ambient overpressure. These results are expected to be useful for the prediction of the breakup characteristics of the Mu-3C during destruction in flight by the V-shaped charges. Author

N88-11753*# Martin Marietta Aerospace, Denver, Colo.
SPACE STATION INTEGRATED PROPULSION AND FLUID SYSTEM STUDY: FLUID SYSTEMS CONFIGURATION DATABOOK
L. Rose, B. Bicknell, D. Bergman, and S. Wilson 9 Jul. 1987 99 p
(Contract NAS8-36438)
(NASA-CR-179215; NAS 1.26:179215; MCR-87-578; EP-2.1)
Avail: NTIS HC A05/MF A01 CSCL 21H

This databook contains fluid system requirements and system descriptions for Space Station program elements including the United States and International modules, integrated fluid systems, attached payloads, fluid servicers and vehicle accommodation facilities. Separate sections are devoted to each of the program elements and include a discussion of the overall system requirements, specific fluid systems requirements and systems descriptions. The systems descriptions contain configurations, fluid inventory data and component lists. In addition, a list of information sources is referenced at the end of each section. M.G.

N88-12012# Tokyo Univ. (Japan). Dept. of Aeronautics.
THRUST AND SPECIFIC IMPULSE OF REPETITIVELY-PULSED-LASER PROPULSION ROCKET
Mengu Cho and Kanji Abe *In its* The Proceedings of the

Symposium on Mechanics for Space Flight Mar. 1987 p 77-96 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

23 CHEMISTRY AND MATERIALS (GENERAL)

N88-11754# Georgia Inst. of Tech., Atlanta. School of Physics.
THE STRUCTURE AND REACTIVITY OF HETEROGENEOUS SURFACES AND STUDY OF THE GEOMETRY OF SURFACE COMPLEXES Progress Report, 1 Jan. - 31 Dec. 1987
Uzi Landman 1987 15 p
(Contract DE-FG05-86ER-45234)
(DE88-000158; DOE/ER-45234/T2) Avail: NTIS HC A03/MF A01

Research activities during 1987 were directed toward the formulation and implementation of new theoretical methods and computational algorithms and their application in studies of materials phenomena of fundamental and technological interests. This research effort resulted in several papers which were submitted and accepted by scientific journals and conference presentations. Certain research activities are highlighted, including some of the written reports, and a list of papers published to date. Included topics are: The Mechanism, Kinetics and Dynamics of Silicon Crystal Growth, Simulations of Amorphous Silicon, Dynamics of Tip Substrate Interactions in Atomic Force Microscopy, Dynamics and Excitations in Coupled Quantum-Classical Systems, and The Physics of Small Clusters. DOE

N88-11755# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POLYVINYL ESTERS OF OMEGA-H-PERFLUOROACIDS AND POLYVINYL ALCOHOL OBTAINED FROM THEM
Ye. N. Rostovskiy and L. D. Budovskaya 24 Aug. 1987 7 p Transl. into ENGLISH from Vysokomolekulyarnyye Soyevineniya, Seriya B, Kratkiye Soobshcheniya (USSR), v. 9, no. 4, Jan. 1987 p 4
(AD-A184633; FTD-ID(RS)T-0766-87) Avail: NTIS HC A02/MF A01 CSCL 07C

By means of radical polymerization at 20 we obtained polyvinyl esters of omega-H-perfluoroacids from monomers. The product of their saponification - polyvinyl alcohol (PVA) - differs significantly from PVA which is obtained by other methods (mainly with respect to its exceptionally high water resistance). It contains 0 to 0.25 percent glycol groups (based on oxidation of periodic acid). When heated higher than the glass transition temperature T sub c = 90 it is crystallized rapidly, and it has a melting point T sub n = 236 (determined dilatometrically) and increased density d20 = 1.315 g/cc. There are no cross bonds in PVA; a melt of it is fluid. PVA dissolved only at a temperature higher than 150 (under pressure). In the IR spectra of PVA a band of absorption of increased intensity was detected at 916/cm. This is characteristic for a syndiotactic structure. GRA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N88-11756*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
MECHANICAL RESPONSE OF UNIDIRECTIONAL BORON/ALUMINUM COMBINED LOADING
Wolfgang Becker, Marek-Jerzy Pindera, and Carl T. Herakovich Oct. 1987 318 p Sponsored by NASA
(NASA-CR-181477; NAS 1.26:181477; VPI-E-87-17; CCMS-87-06) Avail: NTIS HC A14/MF A01 CSCL 11D

Three test methods were employed to characterize the responses of unidirectional Boron/Aluminum metal matrix composite material under monotonic and cyclic loading conditions, namely: Iosipescu Shear, Off-Axis Tension and Compression. The characterization of the elastic and plastic response includes the elastic material properties, yielding and subsequent hardening of the unidirectional composite under different stress ratios in the material principal coordinate system. The elastic response is compared with the prediction of the transformation theory, based on the far field stress, the Pagano-Halpin Model, and finite element analysis. Yield loci generated for different stress ratios are compared for the test methods, taking into account residual stresses and specimen geometry. Subsequently, the yield locus for in-plane shear is compared with the prediction of an analytical, micromechanics model. The influence of the scatter in the experimental data on the predicted yield surface is also analyzed. Lastly, the experimental material strengths in tension and compression are correlated with the Maximum Stress and the Tsai-Wu failure criterion. Author

N88-11757# Oak Ridge National Lab., Tenn.
PROCESSING AND PROPERTIES OF SiC/NICALON COMPOSITES
R. A. Lowden, A. J. Caputo, D. P. Stinton, T. M. Besmann, and M. D. Morris May 1987 26 p Presented at the Fossil Energy Materials Program Conference, Oak Ridge, Tenn., 19 May 1987
(Contract DE-AC05-84OR-21400)
(DE87-013885; CONF-8705103-11) Avail: NTIS HC A03/MF A01

A statistically designed experiment was performed to evaluate the effects of process variables on fiber-reinforced SiC composites fabricated by chemical vapor infiltration. Response surface methodology was applied to study the influence of temperature, pressure, reactant supply rate, and gas ratios on the deposition process and the properties of the produced material. Deposition temperature and total gas flow rates had inverse effects on density and strength, while the effect of pressure was statistically insignificant. Low H2:CH3SiCl3 ratios evoked a positive response in all dependent variables. DOE

N88-11758*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSPLY CRACK DENSITY DETECTION BY ACOUSTO-ULTRASONICS
John H. Hemann, Kenneth J. Bowles, Harold Kautz, and Paul Cavano (Cleveland State Univ., Ohio.) 1987 10 p Presented at Acousto-Ultrasonics: Theory and Application, Blacksburg, Va., 12-15 Jul. 1987
(NASA-TM-100224; E-3843; NAS 1.15:100224) Avail: NTIS HC A02/MF A01 CSCL 11D

The acousto-ultrasonic method was applied to a PMR-15 8-harness, satin Celion 3000 fabric composite to determine the extent of transply cracking. A six-ply 0/90 laminate was also subjected to mechanical loading, which induced transply cracking. The stress wave factor (SWF) is defined as the energy contained in the received signal from a 2.25-MHz center frequency transducer. The correlation of the SWF with transply crack density is shown. Author

N88-11759# Ecole Nationale Superieure des Mines, Evry (France). Centre des Materiaux.
COMPOSITE MATERIALS IN WESTERN EUROPE
A. R. Bunsell Nov. 1985 21 p
(PB87-102943) Avail: NTIS HC E03/MF E01 CSCL 11D

Europe has been active in the field of composite materials from the beginning; however, the major market driving composites have been mainly outside the continent. This situation is changing in the mid-1980s as high quality composites find increasing numbers of outlets and the probability arises of their introduction into high volume mass markets. European suppliers are well placed to take advantage of the expanding markets and the proof of their commitment for example can be seen in the recent purchase of Fiberite by ICI and the purchase by BASF of carbon fiber

manufacturing plants in the USA as well as NARMCO. European manufacturers are following attentively the development of composites and some, such as the automobile industry, are making bold and imaginative use of the materials. GRA

N88-11760# European Space Agency, Paris (France).
CONTRIBUTIONS TO THE INVESTIGATION OF MECHANICAL BEHAVIOR OF GAMMA/GAMMA NbC COTAC COMPOSITES AT MEDIUM AND AT HIGH TEMPERATURE
Claire Damerval May 1987 235 p Transl. into ENGLISH of Contributions a l'Etude du Comportement Mecanique des Composites Cotac Gamma/Gamma-NbC a Moyenne et Haute Temperature (Paris, France, ONERA), 1986
(ESA-TT-1031; ONERA-NT-1986-3; ETN-87-90869) Avail: NTIS HC A11/MF A01

The behavior of gamma/gamma' NbC Cotac fiber composites under creep, transverse tension, thermal cycling under stress, and low-cycle fatigue was studied. In creep, it is demonstrated that in Cotac 784 the transfer of load from matrix to fibers is accompanied by a change in the mechanism of plastic deformation of the matrix during a test. In transverse tensile loading, analysis of the failure mechanisms of Cotac 744 and 784 enables qualitative interpretation of their ductility evolution with temperature, in the light of the yield stress of the matrix, the cohesive stress of the grain boundaries, and the cleavage stress of the lamellae of NbC. Thermal cycling causes the creep lifetime of Cotac 744 and 784 to decrease by a factor of 3 at 1100 C. In low-cycle fatigue, Cotac 784 was characterized at 650 C in tension/compression strain-controlled loading. ESA

N88-11761# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THEORETICAL INVESTIGATION OF STRESS CONCENTRATIONS IN DAMAGED CARBON FIBRE REINFORCED PLASTIC PLATE STRUCTURES. VOLUME 1: MAIN TEXT Final Report
J. P. H. Webber and C. M. L. Wu Jun. 1986 143 p
(Contract MOD-ER/A/9/4/2034/064)
(BR99872-Vol-1; ETN-87-90984) Avail: NTIS HC A07/MF A01

A quasi-three-dimensional quadrilateral isoparametric finite element was developed for the linear-elastic and nonlinear static stress analysis of composite laminates subjected to a uniform in-plane load. Linear-elastic numerical results are obtained for the free edge stress problems of (0/90)s and (+/- 45)s laminates using the quasi-three-dimensional element. The element is also used to analyze variable thickness (stepped) laminated plates of infinite width. An initial stress iteration method using the quasi-three-dimensional element for the nonlinear analysis of CFRP laminates was developed. ESA

N88-11762# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THEORETICAL INVESTIGATION OF STRESS CONCENTRATIONS IN DAMAGED CARBON FIBRE REINFORCED PLASTIC PLATE STRUCTURES. VOLUME 2: TABLES, FIGURES AND PLATES Final Report
J. P. H. Webber and C. M. L. Wu Jun. 1986 220 p
(Contract MOD-ER/A/9/4/2034/064)
(BR99873-Vol-2; ETN-87-90985) Copyright Avail: NTIS HC A10/MF A01

A quasi-three-dimensional quadrilateral isoparametric finite element was developed for the linear-elastic and nonlinear static stress analysis of composite laminates subjected to a uniform in-plane load. Tables, figures, and plates illustrating experiments with the element are presented. ESA

N88-11763 Florida Univ., Gainesville.
THREE-DIMENSIONAL FINITE ELEMENT BASED, INTERATIVE APPROACH FOR ANALYSIS OF LAMINATED COMPOSITES Ph.D. Thesis
Wan-Cheng Hwang 1986 168 p
Avail: Univ. Microfilms Order No. DA8716006

The use of the three-dimensional finite element models based on the three-dimensional elasticity theory for the analysis of layered composite laminates often results in a large numerical model. In order to be able to handle any type of boundary geometry, including curved boundaries, a three-dimensional, finite element iterative approach to analyze multilayer composite laminates was developed. A finite element iterative scheme, based on a continuous mixed field, was introduced. This iterative mixed field method gives much better stress solutions than the standard finite element method for analysis of laminated composites, especially if the mesh is coarse and without high skew distortion. It also provides better displacement solutions in general. This method can be applied to all ranges of thicknesses in laminated composite structural elements with reliable accuracy. In order to demonstrate the efficiency of this method, three types of problems dealing with laminated composites were solved. It was concluded that the iterative method used in finite element stress analysis of laminated composites is a very powerful method to reduce computational resource requirements. Easy implementation in any existing program which is based on the assumed-displacement model and handling of anisotropic materials is another advantage of this method. Dissert. Abstr.

N88-11764# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
LAMINATED FERROUS COMPOSITES BASED ON ULTRAHIGH CARBON (UHC) STEELS Final Report, 1 Oct. 1983 - 30 Apr. 1987
Oleg D. Sherby, Jeffrey Wadsworth, Dong W. Kum, Glenn Deahn, and Jerry Whittenauer 30 Jun. 1987 20 p
(Contract DAAG29-83-K-0153)
(AD-A184617; ARO-21147.1-MS) Avail: NTIS HC A03/MF A01 CSCL 11F

Ferrous laminated composites based on ultrahigh carbon (UHC) steel have been successfully manufactured by roll bonding below the Al transition temperature. Three unique mechanical property characteristics have been achieved by such lamination. First, remarkably high notch-impact properties are achieved in such laminates. This is because notch-blunting occurs by delamination at the good (but not perfect) bond at the interface between laminates. Second, the fatigue properties of UHC steel are improved by lamination for the same reason. The requirements for delamination, however, are much more stringent for fatigue enhancement than for notch-impact enhancement. Third, non-superplastic materials, such as stainless steel, are made superplastic by lamination with fine-grained UHC steel. A ferritic stainless steel was shown to exhibit over 1000 percent elongation at 800 C when tested as a 15 percent stainless steel/UHC steel laminated composite. GRA

N88-11765# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Civil Engineering.
PLASTICITY OF FIBROUS COMPOSITES Final Report, 10 Oct. 1983 - 28 Feb. 1987
George J. Dvorak May 1987 35 p
(Contracts DAAG29-83-K-0171; DAAG29-85-K-0011)
(AD-A184637; ARO-20061.1-EG; ARO-22538.1-EG) Avail: NTIS HC A03/MF A01 CSCL 11D

The purpose of this research program was to establish experimentally verified constitutive relations for isothermal elastic-plastic behavior of metal matrix fibrous composite materials. The theoretical part of the work was concerned with development of new constitutive models of elastic-plastic fibrous composite materials. Our goal was to identify modeling techniques which would permit derivation of overall instantaneous mechanical properties of the aggregate in terms of microstructural geometry and the properties of the phases. Since most fibers remain elastic until failure, the inelastic overall strains are caused by plastic deformation of the matrix. Therefore, an important objective was to find connections between the elastic-plastic deformation of the neat matrix and the composite, and to develop models which would utilize such connections in predictions of the overall response. Also, among the possible approaches to the problem,

it was necessary to identify those which would offer a guarantee of accuracy in applications involving incremental loading which could be verified experimentally. GRA

N88-11766# Mound Lab., Miamisburg, Ohio.
EFFECTS OF SOLVENT EXPOSURES ON POLY(ETHERETHERKETONE) (PEEK) AND PEEK-FIBERGLASS COMPOSITES
Ruth B. Whitaker, Charles R. Brown, Richard S. Carlson, and Phillip D. Trainer 15 Dec. 1986 24 p
(Contract DE-AC04-76DP-00053)
(MLM-3405) Avail: NTIS HC A03/MF A01

To determine the effects of solvent exposure on poly(etheretherketone) (PEEK) composite properties, test specimens of PEEK and PEEK-fiberglass (FG) were exposed to a number of solvents, and, after removal of the solvents, were tested for changes in weight, tensile strength, and thermal/chemical properties. The solvents chosen included several encountered in normal processing of PEEK composites into Mound components. Solvents tested included: Alconox/water, ethanol, trichloroethylene, ethylene glycol, toluene, Freon TF, silicone oil, and dilute (15%) NaOH and H2SO4 solutions. Exposures were for five days at temperatures up to 80 C. The only significant decreases in tensile strength after solvent exposure occurred with the dilute NaOH-exposed PEEK-FG specimens. Several samples showed minor weight changes. Author

N88-11767*# Johns Hopkins Univ., Baltimore, Md. Center for NDE.
ULTRASONIC CHARACTERIZATION OF THE NONLINEAR ELASTIC PROPERTIES OF UNIDIRECTIONAL GRAPHITE/EPOXY COMPOSITES Final Report
William H. Prosser Washington NASA Oct. 1987 198 p
(Grant NGT21-001-802)
(NASA-CR-4100; NAS 1.26:4100) Avail: NTIS HC A09/MF A01 CSCL 11D

The theoretical treatment of linear and nonlinear elasticity in a unidirectionally fiber reinforced composite as well as measurements for a unidirectional graphite/epoxy composite (T300/5208) are presented. Linear elastic properties were measured by both ultrasonic and strain gage measurements. The nonlinear properties were determined by measuring changes in ultrasonic natural phase velocity with a pulsed phase locked loop interferometer as a function of stress and temperature. These measurements provide the basis for further investigations into the relationship between nonlinear elastic properties and other important properties such as strength and fiber-matrix interfacial stength in graphite/epoxy composites. Author

N88-11794# Joint Publications Research Service, Arlington, Va.
CORROSION-ELECTROCHEMICAL AND MECHANICAL PROPERTIES OF COMPOSITE GRAPHITE-CARBIDE METAL MATERIALS BASED ON TITANIUM AND ITS ALLOYS Abstract Only
N. D. Tomashov, T. V. Chukalovskaya, I. K. Krylov, V. S. Nabokov, V. S. Mikheyev, B. A. Goncharenko, and N. I. Iudina *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 12 Transl. into ENGLISH from Zashchita Metallov (Moscow, USSR), v. 22, no. 5, Sep.-Oct. 1986 p 684-691 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

N88-11795# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT AND APPLICATION OF COMPOSITES
N. Lazareva *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 24-30 Transl. into ENGLISH from Znaniye-Sila (Moscow, USSR), no. 9, Sep. 1986 2 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-11768# Cornell Univ., Ithaca, N.Y.
COMBUSTION CONTROL WITH SMART SENSORS Final Report, 1 Feb. 1982 - 30 Nov. 1986
F. C. Gouldin and G. J. Wolga Jul. 1987 46 p
(Contract DE-AC02-82ER-12019)
(DE87-013688; DOE/ER-12019/1) Avail: NTIS HC A03/MF A01

A measurement system, utilizing a runable acoustooptic filter as a smart spectroscopic sensor, has been designed and operated to determine composition and temperature of combustion gases. The system quantitatively measures infrared absorption integrated over a linear path through the combustion products on several lines of a vibration-rotation band of each gas component, after which, data analysis yields the composition and gas temperature. The computer controlled system is spectroscopically self-calibrating and is suited for process control applications. The system has been tested on CO and CO2 produced in a flat-flame burner in which methane-air mixtures are burned. Proof-of-Principle has been demonstrated. Additional theoretical work has been done to deal with the condition of spatially non-uniform gas mixtures, which will occur closer to the combustor, knowledge of which could be significant in many process control applications. Spatially resolved data on gas temperature and composition can be obtained from multiple line-of-sight absorption measurements coupled with suitable inversion methods. The inversion problem is related to the X-ray tomographic technique but differs because the gradients in temperature and composition can be assumed to be small. The inversion work has focused on numerical and theoretical aspects of the problem. Two distinct inversion methods have resulted. DOE

N88-11769# Oak Ridge National Lab., Tenn.
THIRD-HARMONIC GENERATION AND MULTIPHOTON IONIZATION SPECTROSCOPY
C. Fotakis, J. A. D. Stockdale, and M. J. Proctor 1987 5 p Presented at the NATO Workshop on Atomic and Molecular Processes With Short Intense Laser Pulse, Sherbrooke, Quebec, 19 Jul. 1987 Prepared in cooperation with Crete Univ., Iraklion, Greece
(Contract DE-AC05-84OR-21400)
(DE87-013545; CONF-870784-3) Avail: NTIS HC A02/MF A01

Nonlinear phenomena, such as multiphoton excitation (MPE) processes leading to ionization and third-harmonic generation (THG) in gases have become the issue of extensive studies over recent years. Studies in rare gases in particular have resulted in several interesting observations in this respect. Thus, it has been established that three-photon resonantly enhanced multiphoton ionization (MPI) in the vicinity of states which are single photon optically coupled to the ground state may occur in efficient competition with THG. The present work demonstrates several new effects which may appear when third-harmonic radiation is present during MPI. DOE

N88-11770# Sandia National Labs., Albuquerque, N. Mex.
LASER SPECTROSCOPY AND GAS-PHASE CHEMISTRY IN CVD
P. Ho, M. E. Coltrin, and W. G. Beiland 1987 3 p Presented at the 34th National Vacuum Symposium and Topical Conference, Anaheim, Calif., 2 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013715; SAND-87-2320C; CONF-871125-2) Avail: NTIS HC A02/MF A01

A coordinated program of experimental and theoretical research into the fundamental mechanisms of CVD is described. The experimental part of the program involves the use of laser

spectroscopic techniques for in situ measurements during CVD. The theoretical part of the program consists of a computer model that contains a detailed description of the coupled fluid mechanics and gas-phase chemical kinetics for silane CVD. DOE

N88-11771# Florida State Univ., Tallahassee. Inst. of Molecular Biophysics.
ENERGY TRANSFORMATION IN MOLECULAR ELECTRONIC SYSTEMS Research Progress Report, 1 Dec. 1986 - 30 Nov. 1987
M. Kasha 1 Aug. 1987 9 p
(Contract DE-FG05-87ER-60517)
(DE87-013916; DOE/ER-60517/1) Avail: NTIS HC A02/MF A01

The main research activity on our project continues to be the very active field of proton-transfer spectroscopy. Categories of research are: (1) systematics of proton-transfer classes; (2) picosecond spectroscopy of proton-transfer in Lumichrome (a photolysis product of riboflavin); (3) proton-transfer laser research; (4) computer calculations on Proton-transfer systems; and (5) unscheduled research. New facets of the research program are: (1) charge-transfer (CT) perturbation of proton-transfer spectroscopy; (2) super computer calculations on proton-transfer; (3) dielectric effects on extended dipoles in proton-transfer spectroscopy; and (4) proton-transfer in biological systems. DOE

N88-11772# Tennessee Univ., Knoxville. Dept. of Physics and Astronomy.
VACUUM ULTRAVIOLET ELECTRONIC PROPERTIES OF LIQUIDS Annual Progress Report, 1 Feb. - 31 Jan. 1988
Linda R. Painter Sep. 1987 14 p
(Contract DE-FG05-86ER-60415)
(DE88-000165; DOE/ER-60415/3) Avail: NTIS HC A03/MF A01

This paper contains a progress report on experiments done on the electronic properties of liquids in the far ultraviolet region. Topics discussed in this report are: a new scanning-tunneling microscope, photoemission phenomenon from liquids, ionic doping, and surface charging in liquids. DOE

N88-11773# Argonne National Lab., Ill. Chemical Technology Div.
[HIGHLIGHTS OF THE CHEMICAL TECHNOLOGY DIVISION'S RESEARCH ACTIVITIES] Annual Technical Report, 1986
Jun. 1987 225 p
(Contract W-31109-eng-38)
(DE88-000233; ANL-87-19) Avail: NTIS HC A10/MF A01

Highlights of the Chemical Technology (CMT) Division's activities during 1986 are presented. In this period, CMT conducted research and development in areas that include the following: (1) high-performance batteries - mainly lithium-alloy/metal sulfide and sodium/sulfur; (2) aqueous batteries (lead-acid, nickel/iron, etc.); (3) advanced fuel cells with molten carbonate or solid oxide electrolytes; (4) coal utilization, including the heat and seed recovery technology for coal-fired magnetohydrodynamics plants, the technology for fluidized-bed combustion, and a novel concept for CO recovery from fossil fuel combustion; (5) methods for recovery of energy from municipal waste; (6) methods for the electromagnetic continuous casting of steel sheet; (7) techniques for treatment of hazardous waste such as reactive metals and trichloroethylenes; (8) nuclear technology related to waste management, a process for separating and recovering transuranic elements from nuclear waste, and the recovery processes for discharged fuel and the uranium blanket in a sodium-cooled fast reactor; and (9) physical chemistry of selected materials in environments simulating those of fission and fusion energy systems. DOE

N88-11774# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
SUPERCRITICAL FLUID CHROMATOGRAPHY/SUPERSONIC JET SPECTROSCOPY Progress Report, 1 Jun. - 31 Aug. 1987
Steven R. Goates and Milton L. Lee Sep. 1987 9 p
(Contract DE-FG22-86PC-90534)
(DE88-000297; DOE/PC-90534/6) Avail: NTIS HC A02/MF A01

Earlier problems with loss of sensitivity are solved, and chromatographic studies with supersonic jet detection using perylene as a test compound begun. The first attempts were made with a 10 m-long, 50 micron diameter, C8-stationary phase column and a 2.5 micron pinhole restrictor. Previous problems were identified with chromatographic resolution with the transfer capillary leading from the oven to the nozzle. In these experiments no transfer column was used, and the chromatographic column was run to the nozzle. Carbon dioxide was the mobile phase; the column temperature was maintained at 50 C, and the nozzle temperature, at 200 C. The pinhole was sealed to the column end as was done in the past. Results of these first trials are somewhat difficult to interpret. Firstly, it was clear that the linear velocity with this column and restrictor were too great for good chromatographic resolution. However, perylene was detected at the nanogram level at 300 atm or greater pressures. Signal intensity dropped off with decreasing pressure, even though no appreciable band broadening was observed. The lack of significant tailing in the eluted band, at all pressures down to 150 atm, suggests that the flow is sufficiently directed out of the nozzle that dead volume is not a problem, but the possibility that the apparent sample loss is associated with the nozzle connection led to a revision of the direct expansion nozzle. The pinhole disk is sealed from the back so that it is flush with the capillary column. Another area of possible interference is either a hot or a cold spot in the heated-nozzle interface. DOE

N88-11775*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETAILED MECHANISM OF BENZENE OXIDATION
David A. Bittker Oct. 1987 24 p
(NASA-TM-100202; E-3797; NAS 1.15:100202) Avail: NTIS HC A03/MF A01 CSCL 07D

A detailed quantitative mechanism for the oxidation of benzene in both argon and nitrogen diluted systems is presented. Computed ignition delay time for argon diluted mixtures are in satisfactory agreement with experimental results for a wide range of initial conditions. An experimental temperature versus time profile for a nitrogen diluted oxidation was accurately matched and several concentration profiles were matched qualitatively. Application of sensitivity analysis has given approximate rate constant expressions for the two dominant heat release reactions, the oxidation of C6H5 and C5H5 radicals by molecular oxygen. Author

N88-11776# Technische Univ., Brunswick (West Germany). Naturwissenschaftlichen Fakultaet.
OPTICAL DETERMINATION OF THE VIRIAL COEFFICIENTS OF THE GASES C2H4, C2H6 AND SF6 Ph.D. Thesis [OPTISCHE BESTIMMUNG VON VIRIALKOEFFIZIENTEN DER GASE C2H4, C2H6 UND SF6]
Henry Haeusler 1986 134 p In GERMAN
(ETN-87-90610) Avail: NTIS HC A07/MF A01

The third thermodynamic virial coefficients of C2H4, C2H6, and SF6 were determined as a function of temperature using an optical interferometric method based on the refraction index. The effects of the measuring apparatus, the pressure measurement, and the mathematical evaluation methods on the virial coefficients were determined. The pressure measurement has to be improved with respect to resolution and hysteresis. The measurement of the refraction index can be improved using a longer cuvette. The use of a faster interface-computer system for the data acquisition could significantly reduce the measuring time. The most important results are the qualitatively similar curves of the investigated gases; a maximum of the virial coefficients is found in the neighborhood of the critical temperature. ESA

N88-11777# European Space Agency, Paris (France).
HIGH TEMPERATURE CO2 STUDY: ANTI-STOKES COHERENT RAMAN DIFFUSION AND INFRARED SPECTROSCOPY
Nicole Papineau May 1987 237 p Transl. into ENGLISH of

Etude de CO2 a Temperature Elevee: Diffusion Raman Anti-Stokes Coherent et Spectroscopie Infrarouge (Paris, France, ONERA), 1986 Original language document was announced as N87-20402 (ESA-TT-1048; ONERA-P-1986-2; ETN-87-90871) Avail: NTIS HC A11/MF A01

Coherent Anti-Stokes Raman scattering spectra were recorded at 300, 800, 1200, and 1500K with a 0.07 mm spectral resolution. Intense bands are located in this spectral region, coupled by Fermi resonance. The Q branches and the O and S branch lines of many vibration-rotation bands are assigned. A simulation of the experimental spectra at 300 and 800K was performed. Spectroscopic data compilations in the 4.3 and 2.7 micrometer regions were generated. These reproduce the experimental spectra up to 1500K in a satisfactory way. ESA

N88-11778# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Micro-Ondes.
MEASUREMENT OF SOLID PROPELLANT COMBUSTION VELOCITY BY MEANS OF MICROWAVES Final Report [MESURE DE LA VITESSE DE COMBUSTION DES PROPERGOLS SOLIDES PAR MICRO-ONDES]
J. deMontaigne and A. Deficis Jan. 1986 126 p In FRENCH
(Contract DRET-85-34-001)
(CERT-1/1316-MO; ETN-87-90901) Avail: NTIS HC A07/MF A01

A measuring system based on the detection of phase variations of extremely high frequency waves, caused by deformation of the optical path due to the flame front was developed. The goals included the improvement of a numerical model, the elimination of problems of the experimental set-up, and the development of improved digital signal processing procedures. The results indicate partial success. ESA

N88-11779# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
COMBUSTION IN TURBULENT JETS AND BUOYANT FLAMES Annual Report, 1 Dec. 1985 - 30 Nov. 1986
P. E. Dimotakis, J. E. Broadwell, and E. E. Zukoski 28 Dec. 1986 95 p
(Contract GRI-5083-260-0878)
(PB87-232674; GRI-87/0218) Avail: NTIS HC A05/MF A01 CSCL 21B

Results are reported from an ongoing investigation of the entrainment and mixing mechanisms in momentum-dominated turbulent jets, buoyancy-dominated turbulent plumes, and flows which undergo a transition between these two regimes. The investigation also addresses the effects of molecular diffusion rates (Schmidt number) and combustion heat release on these mechanisms and incorporates these mechanisms into practical modeling and predictive techniques for combustion in these flows. Large buoyant diffusions flames were imaged using laser soot-scattering with the beam oriented both perpendicular and parallel to the burner axis. Improvements to the momentum-driven/transitional jet facility will allow greater experimental latitude. The High Pressure Reactant Vessel was installed and the flow control and mixing system were designed. Final integration of the system is about to commence. Entrainment and flame length measurements in momentum-dominated and transitional jets were performed more accurately than was previously possible. The entrainment results indicate a narrow transitional region, while the flame length measurements show variation well into the momentum dominated regime.Past theoretical work on finite reaction rate effects in the reacting shear layer are being extended to attempt to understand the turbulent reacting jet. GRA

N88-11780# Ballistic Research Labs., Aberdeen Proving Ground, Md.
PHOTOCHEMICAL IGNITION STUDIES. 3: IGNITION BY EFFICIENT AND RESONANT MULTIPHOTON PHOTOCHEMICAL FORMATION OF MICROPLASMAS Final Report, Jun. 1985 - Mar. 1986
Brad E. Forch and Andrzej W. Miziolek Jun. 1987 29 p
(AD-A184644; BRL-TR-2809-Pt-3) Avail: NTIS HC A03/MF A01 CSCL 07D

This is the third of a series of reports concerning the activation (ignition) of reactive gases using focused ultraviolet lasers. The goal of this research is to ascertain the potential of uv laser multiphoton photochemical ignition as a primary igniter or ignition augmentation source for propellants or their pyrolysis products. In this report, ignition properties of premixed H2/O2 and H2/N2O flows at atmospheric pressure have been studied. Tuning the laser in the 225.6 nm wavelength region has yielded three minima in the amount of incident laser energy (ILE) that is required to ignite either mixture. The minima correspond exactly to the two-photon resonant excitation wavelengths for the three spin-orbit split ground electronic states of oxygen atoms. A determination of the ILE necessary to ignite both premixed flows as a function of equivalence ration shows a minimum far into the fuel-lean region. Additional time-resolved spectral studies were carried out on O2 and N2O flows alone. These indicated a resonant formation of a microplasma with a lifetime on the order of 100 nsec. GRA

N88-11781# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
IGNITION AND FLAME PROPAGATION IN SPRAYS Final Report, 1984 - 1987
S. C. Yao, W. A. Sirignano, M. Queiroz, and R. H. Rangel (California Univ., Irvine.) 10 Jul. 1987 9 p
(Contract DAAG29-84-K-0077)
(AD-A184679; ARO-21254.14-EG) Avail: NTIS HC A02/MF A01 CSCL 07D

A theoretical model of ignition and flame propagation in a spray consisting of a number of parallel droplet streams is presented. The analysis is based on a simplified representation of the fluid-mechanic aspects of the flow while focusing on the details of the heat transfer, vaporization, ignition, and flame propagation mechanisms across the various streams. In this simplified model, the fuel droplets are represented as discrete parallel streams which are continuous in the streamwise direction. With this configuration, steady state analyses are performed to investigate the influence of several parameters such as fuel volatility, droplet size, equivalence ratio, number of streams, and stream arrangement on heat transfer, vaporization, ignition, and flame propagation mechanisms in the spray. An experimental exploration of the dynamic nature of the ignition and burning phenomenon and the thermal structure of a planar spray flame was performed. The influence of important spray parameters (e.g., fuel vapor concentration, and turbulence intensity) on the flame front motion was investigated, using sequential photographic information. Then the performance of micro-thermocouples for the measurement of gas-phase temperature in the presence of droplets was studied in a special gas flame as a means to analyze the thermal structure of the planar spray flame. GRA

N88-11782# Lawrence Livermore National Lab., Calif.
DETAILED KINETIC MODELING OF AUTOIGNITION CHEMISTRY
C. K. Westbrook and W. J. Pitz 22 Jul. 1987 55 p Presented at the International Fuels and Lubricants Meeting and Exposition, Toronto, Ontario, 2 Nov. 1987
(Contract W-7405-eng-48)
(DE87-013226; UCRL-97082; CONF-871142-2) Avail: NTIS HC A04/MF A01

The development of detailed chemical kinetic reaction mechanisms for analysis of autoignition and knocking of hydrocarbon fuels is described. In particular, kinetic processes of concern for the oxidation of complex hydrocarbon fuel molecules are emphasized. The wide ranges of temperature and pressure which are encountered by end gases in automobile engine combustion chambers result in extreme demands on reaction mechanisms which are intended to describe knocking conditions and predict rates of combustion and ignition. The reactions and chemical species which are most important in each temperature and pressure regime are discussed, and the validation of these

reaction mechanisms through comparison with idealized experimental results is described. DOE

N88-11783# Sandia National Labs., Albuquerque, N. Mex.
MEASUREMENTS IN LARGE JP-4 POOL FIRES
N. R. Keltner, L. A. Kent, and M. E. Schneider 1987 4 p Presented at the Combined Meetings of the Eastern Section of the Combustion Institute 20th Fall Technical Meeting on Chemical and Physical Processes in Combustion and National Bureau of Standards Annual Conference, Gaithersburg, Md., 2 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013445; SAND-87-1920C; CONF-871131-1) Avail: NTIS HC A02/MF A01

Over the past four years, Sandia National Laboratories has conducted a number of large pool fire tests to evaluate the design of radioactive material (RAM) shipping containers. Some of these tests have been designed to define the thermal environment and some have been used for certification testing. In each test there have been a number of fire diagnostic measurements. The simplest sets of diagnostics have involved measurements of temperature at several elevations on arrays of towers, measurements of hot wall heat flux with small calorimeters suspended from the towers, the average fuel recession rate, and the wind speed and direction. The most complex sets of diagnostics have included the above and in various tests added radiometers in the lower flame zone, centerline velocity measurements at a number of elevations, radiometers and calorimeters at the fuel surface, large cylindrical and flat plate calorimeters, infrared imaging, time resolved fuel recession rates, and a variety of soot particle concentration and size measurements made in the plume with a tethered balloon and an instrumented airplane. All of the large fires have been conducted in a 9.1 m by 18.3 m pool using JP-4 as the fuel. Typical duration is one-half hour. Covering all of the results is beyond the scope of a single paper. Conditionally sampled temperature and velocity measurements from one fire will be presented; for this fire, a 20 cm layer of fuel was floated on 61 cm of water. Pool surface heat flux, fuel recession rate data, and smoke emission data from a second fire are given. Because the wind has a strong effect on the temperature and velocity measurements, conditional sampling has been used to try to obtain data during periods of low winds. DOE

N88-11784# Lawrence Livermore National Lab., Calif.
HIGH PRESSURE AUTOIGNITION OF NATURAL GAS/AIR MIXTURES AND THE PROBLEM OF ENGINE KNOCK
C. K. Westbrook and W. J. Pitz 3 Aug. 1987 4 p Presented at the Combustion Institute Fall Meeting, Honolulu, Hawaii, 22 Nov. 1987
(Contract W-7405-eng-48)
(DE87-013799; UCRL-97180; CONF-871118-1) Avail: NTIS HC A02

A detailed chemical kinetic reaction mechanism is used in a numerical model to examine the rate of autoignition in mixtures of natural gas and air under conditions which occur in internal combustion engines. The effects of variations in typical engine operating parameters on this autoignition rate are assessed, and the rate of ignition is related to the onset of engine knock. DOE

N88-11785# Sandia National Labs., Albuquerque, N. Mex.
FLAMMABILITY LIMITS IN COCURRENT SMOLDERING COMBUSTION
S. S. Dosanjh Aug. 1987 9 p Presented at the Combustion Institute Fall Meeting, Honolulu, Hawaii, 22 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE87-014102; SAND-87-1357C; CONF-871118-4) Avail: NTIS HC A02/MF A01

The effect of heat losses on cocurrent (premixed-flame-like) smoldering combustion is investigated using activation energy asymptotics. Expressions for the smolder velocity and the maximum temperature were derived in the limit of large activation energies. Heat losses were taken to vary with temperature. One result was that solutions ceased to exist when either the oxygen concentration or the inlet oxygen mass flux was lowered below certain critical values. Flammability limits were determined for a polyurethane foam. DOE

N88-11786# Sandia National Labs., Albuquerque, N. Mex.
FLAME ACCELERATION AND TRANSITION TO DETONATION IN CHANNELS
M. P. Sherman, S. R. Tieszen, and W. B. Benedick 1987 4 p Presented at the Combustion Institute Fall Meeting, Honolulu, Hawaii, 22 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE87-014193; SAND-87-1444C; CONF-871118-3) Avail: NTIS HC A02

Experimental results are reported for combustion of pre-mixed H2-air mixtures in a 136 cu m channel and a 1:12.6 linear scale model. Test variables include H2-air equivalence ratio, obstacles and degree of transverse venting. The results show that flame acceleration is increased by sensitive mixtures, presence of obstacles, large scales, and insufficient venting. The results also support the hypothesis that deflagration to detonation transition (DDT) can occur if the ratio of detonation cell width to channel width is less than a critical value, provided that the flame speed prior to transition has approached the isobaric sound speed. DOE

N88-11787# Lawrence Livermore National Lab., Calif.
NUMERICAL SIMULATION OF TURBULENT PREMIXED COMBUSTION AND DECAY OF TURBULENT SWIRLING FLOW
L. D. Cloutman 1987 7 p Presented at the Combustion Institute Fall Meeting, Honolulu, Hawaii, 22 Nov. 1987
(Contract W-7405-eng-48)
(DE87-014253; UCRL-96680; CONF-871118-5) Avail: NTIS HC A02/MF A01

In recent years multidimensional numerical models have been developed to predict reacting flows in a wide variety of combustion systems. These models must be validated by comparing them to experimental results. This paper presents three numerical simulations using the KIVA and CONCHAS-SPRAY hydrodynamics programs. The KIVA program produces numerical solutions of the full nonlinear, transient, compressible flow, Navier-Stokes equations in two and three dimensions, including moving boundaries, chemical reactions, and turbulence models. The numerical algorithm is based on the arbitrary Lagrangian-Eulerian (ALE) technique. CONCHAS-SPRAY is the two-dimensional ICED-ALE program that was extended to produce KIVA. DOE

N88-11788# Chemical Dynamics Corp., Upper Marlboro, Md.
THE CALCULATION OF THERMAL RATE CONSTANTS FOR GAS-PHASE AND HETEROGENEOUS REACTIONS IN COMBUSTION PROCESSES Final Report, 1 Jun. 1984 - 31 May 1987
Bruce C. Garrett 28 Jul. 1987 11 p
(Contract DAAG29-84-C-0011)
(AD-A184435; ARO-21301.30-CH-S) Avail: NTIS HC A03/MF A01 CSCL 21B

This final report summarizes work performed on a three year research program to develop theoretical methods to aid in the interpretation and modeling of combustion processes. The methods developed are based upon variational transition state theory and applied to gas-phase and heterogeneous reactions. GRA

N88-11789# Florida Univ., Gainesville. Quantum Theory Project.
DEVELOPMENT OF MANY-BODY METHODS FOR FLAME CHEMISTRY AND LARGE MOLECULE APPLICATIONS Final Report, 1 Mar. 1985 - 28 Feb. 1987
Rodney J. Bartlett 13 May 1987 27 p
(Contract DAAG29-84-K-0025)
(AD-A184451; ARO-21033.12-PH) Avail: NTIS HC A03/MF A01 CSCL 07D

Ab initio MBPT and coupled cluster (CC) gradient methods have been developed for studies of potential energy surfaces for molecules. Example calculations include N2H2, SiC2, B2H6 and BH3 and nucleic acid bases among others. Detailed first principle

correlated predictions of IR spectra, frequencies and intensities are reported. These methods are used to search for the unknown N3H3 molecule. It is found that it should exist in three stable forms. Detailed IR spectra are provided to aid in its identification. The same methods demonstrate that the currently accepted experimental spectra of the transient BH3 molecule is misinterpreted. Additional work focused on the development and use of MBPT/CC methods in large molecule studies. Methods are developed based upon localized orbitals that should make it possible to study much larger molecules than is currently possible. Other MBPT/CC results are reported for the relative stabilities of nucleic acid bases, particularly cytosine. Such tautomers are important in the theory of point mutations that can lead to tumor formation. It is demonstrated that the effects of electron correlation are crucial in determining accurate energy differences. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-11790# Oak Ridge National Lab., Tenn.
EFFECT OF IRRADIATION ON THE TENSILE PROPERTIES OF NIOBIUM-BASE ALLOYS
M. L. Grossbeck, R. L. Heestand, and S. D. Atkin Nov. 1986 7 p Presented at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12 Jan. 1987 Prepared in cooperation with Hanford Engineering Development Lab., Richland, Wash.
(Contract DE-AC05-84OR-21400)
(DE87-002409; CONF-870102-7) Avail: NTIS HC A02/MF A01

The alloys Nb-1Zr and PWC-11 (Nb-1Zr-0.1C) were selected as prime candidate alloys for the SP-100 reactor. Since the mechanical properties of niobium alloys irradiated to end-of-life exposure levels of about 2 x 10 to the 26th neutrons/sq m (E is greater than 0.1 MeV) at temperatures above 1300 K were not available, an irradiation experiment (B-350) in EBR-II was conducted. Irradiation creep, impact properties, bending fatigue, and tensile properties were investigated; however, only tensile properties will be reported in this paper. The tensile properties were studied since they easily reveal the common irradiation phenomena of hardening and embrittlement. Most attention was directed to testing at the irradiation temperature. Further testing was conducted at lower temperatures in order to scope the behavior of the alloys in cooldown conditions. DOE

N88-11791# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: MATERIALS SCIENCE
6 Jul. 1987 84 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-87-006) Avail: NTIS HC A05/MF A01

Translations of articles from various books and journals are presented. Many areas of Materials Science are covered: Analysis, Testing; Coatings; Corrosion; Ferrous Metals; Nonferrous Metals, Alloys, Brazes, Solders; Nonmetallic Materials; Preparations; Welding, Brazing, Soldering; and Extractive Metallurgy, Mining. For individual titles, see N88-11792 through N88-11800.

N88-11792# Joint Publications Research Service, Arlington, Va.
SUPERCONDUCTIVITY OF PSEUDOBINARY COMPOUNDS A15 (V-Cr)3Si, (V-MO)3Si, Mo3(Si-Re), BOMBARDED WITH FAST NEUTRONS Abstract Only c76
A. Ye. Karkin, V. Ye. Arkhipov, A. V. Mirmelshteyn, V. I. Voronin, A. K. Shtolts, and B. N. Goshchitskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 4 Transl. into ENGLISH from Fizika Metallov i Metallovedeniye (Sverdlovsk, USSR), v. 62, Iss. 2, Aug. 1986 p 291-297 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

A study is made of the influence of neutron bombardment on the behavior of T sub c (superconducting state transition temperature), second critical field H sub c2 and electrical resistance rho (T) of the compounds mentioned in the title. When quasibinary compounds Al5 are bombarded with fast neutrons, T sub c decreases where z (average number of electron per atom) = 4.5 to 5.0, increasing where z = 5.0 to 6.0 and decreasing slightly where z = 6.25 to 6.5. The variation of T sub c as a function of z for compounds based on V, Cr, Nb and Mo is transformed from a 2 peak curve to a monotonically increasing curve similar to T sub c (z) observed for amorphous metals, disordered compounds and alloys with different crystalline structures. The Al5 compounds lose their individuality upon disordering or amorphization. The density of electron states at the Fermi level N (E sub F) is not simply related with the behavior of T sub c. Correlation of T sub c and N (E sub F) is weak or nonexistent. Author

N88-11793# Joint Publications Research Service, Arlington, Va.
CORROSION RESISTANCE OF SILVER-PLATED CARBON-ALUMINUM COMPOSITE Abstract Only c27
E. Z. Napukh, I. M. Zhitkikh, A. I. Stepanov, A. T Manuylov, M. I. Morozova, S. I. Vorobeva, B. F. Trefilov, and N. P. Ignatova *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 10 Transl. into ENGLISH from Poroshkovaya Metallurgiya (Kiev, USSR), no. 8, Aug. 1986 p 45-47 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

The corrosion resistance of silver plated carbon aluminum composite with matrices of aluminum alloys in the Al-Si(1), Al-Zn-Mg(2) and Al-Mg-Si(3) systems was studied. Silver plating was performed in a cyanide-thiocyanate electrolyte over a sublayer of nickel and copper precipitated from an ethylene diamine electrolyte. Study of microsections showed that delamination of the matrix, pitting at points where carbon fibers protrude, occurs during its preparation and nickeliding, resulting in precipitation of chemical nickel, copper and silver at such defects, with porosity greater than that of the same coatings on uniform surfaces. It is concluded that gool quality coatings on carbon aluminum composites, providing good corrosion resistance and functional properties, can be obtained only if the thickness of the surface layer of aluminum containing no carbon fibers is at least as great as the thickness removed upon preparation for nickeliding, i.e., at least 30 to 40 microns. Author

N88-11794# Joint Publications Research Service, Arlington, Va.
CORROSION-ELECTROCHEMICAL AND MECHANICAL PROPERTIES OF COMPOSITE GRAPHITE-CARBIDE METAL MATERIALS BASED ON TITANIUM AND ITS ALLOYS Abstract Only c24
N. D. Tomashov, T. V. Chukalovskaya, I. K. Krylov, V. S. Nabokov, V. S. Mikheyev, B. A. Goncharenko, and N. I. Iudina *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 12 Transl. into ENGLISH from Zashchita Metallov (Moscow, USSR), v. 22, no. 5, Sep.-Oct. 1986 p 684-691 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

A study is made of the corrosion electrochemical and mechanical properties of composite carbide graphite metal materials obtained by volumetric saturation of type EG-O graphite with 20 to 25 percent porosity with Ti and alloys Ti-8Si and KRST-1, a corrosion resistant Ti based alloy containing Mo, Nb and Zr, and also by precipitation of Ti from the gas phase onto a graphite matrix. The specimens produced were used to determine the mechanical characteristics, density, and phase composition of the outer surface layer and volume of the specimens. The materials obtained were found to have much greater strength than graphite and good surface layer hardness, while being much superior to Ti and KRST-1 alloy in terms of corrosion resistance in nonoxidative corrosive media at 100 C. The electrochemical behavior of the EG-O-Ti material showed that the anodic and cathodic properties of the material in H2SO4 at 50 C are determined by the Ti-carbide. The hydrogen overvoltage of the material is some 300 mV lower than that of graphite and Ti. At cathode polarization, the hydrogen is absorbed in the carbide layer, so that the hydrogen overvoltage

is reduced and the electrode acts like a reverse hydrogen electrode. Author

N88-11795# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT AND APPLICATION OF COMPOSITES c24
N. Lazareva *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 24-30 Transl. into ENGLISH from Znaniye-Sila (Moscow, USSR), no. 9, Sep. 1986 p 2 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

An interview is presented between a journalist and a USSR scientist from the Composite Laboratory of the Metallurgy Institute. The scientist tells of a new designing method whose unusual potentialities are not based on complex equipment or on tons of reports and sketches, but on the material itself and the product to be. Various applications of the composite materials are briefly examined. E.R.

N88-11796# Joint Publications Research Service, Arlington, Va.
PRODUCTION OF METALLIC MONOCRYSTALS DESCRIBED c76
A. I. Manokhin *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 40-49 Transl. into ENGLISH from Khimiya I Zhizn (Moscow, USSR), no. 5, May 1986 p 2-7 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

Molybdenum and tungsten are brittle at room temperature but in their pure monocrystalline form, they become highly plastic and stay that way even at the temperature of liquid nitrogen (-196 C). In their fibrous form, the whiskers of many metals show a strength greatly exceeding their actual strength and reaching theoretical values. This phenomenon is determined by the forces of interatomic adhesion. Monocrystalline metals show a high degree of anisotropy. The removal of impurities and production of monocrystals is an effective means of creating metal structures with certain properties. These materials are discussed as to their production and their uses. E.R.

N88-11797# Joint Publications Research Service, Arlington, Va.
GSSR POWDER METALLURGY RESEARCH, PRODUCTION EXPANDING
Yuriy Kartvelishvili *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 56-59 Transl. into ENGLISH from Zarya Vostoka (Tbilisi, USSR), 3 Oct. 1986 p 2 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

The recently adopted decrees of the CPSU Central Committee and the USSR Council of Ministers provide specific measures for accelerating the development of powder metallurgy in order to meet the economy's demand for metal powders and articles made from them, as well as to raise the technical level of powder metallurgy by implementing leading technology. A Republic Scientific Center for Powder Metallurgy and Powder Coatings has been established. Based on developments made at the center, powder metallurgy sections have been and are being established at a number of the republic's enterprises. These developments are discussed and utilization of the developing technology is examined. E.R.

N88-11798# Joint Publications Research Service, Arlington, Va.
RESISTANCE OF WELDED JOINTS IN HIGH TEMPERATURE HASTELLOY N-TYPE NICKEL ALLOY TO HOT CRACK FORMATION Abstract Only c39
K. A. Yushchenko, V. N. Lipodayev, M. V. Belchuk, G. N. Gordan, and O. V. Novichkova *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 64 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 9, Sep. 1986 p 10-12 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

The topography and morphology of hot cracks in welded joints of a high temperature nickel alloy in the nickel chromium molybdenum system was refined. The crack resistance of welded joints in an experimental Hastelloy N alloy was studied. Butt joints of rigidly clamped 10 mm thick plates were made by multipass argon arc welding with a nonfusible electrode using a 3 mm diameter wire with a composition similar to that of the base metal. Cracks were located, cut out, and then studied on a scanning electron microscope. A microanalyzer was used to estimate the microheterogeneity of the metal in various zones of the joints. The experimental data indicate that the formation of hot cracks in welded joints of a multicomponent nickel alloy of the Hastelloy N type is related both to the existence in the crystallizing metal of residual liquid rich in segregated material and to the presence of low melting point inclusions at the intercrystalline and recrystallization boundaries of the austenite, causing a drop in the melting point of these boundaries. The welded joints show a tendency to formation of both crystallization and liquation cracks in the seam metal and heat affected zones. Author

N88-11799# Joint Publications Research Service, Arlington, Va.
STRESS STATE OF WELDED JOINTS OF DISSIMILAR MATERIALS OBTAINED BY DIFFUSION WELDING Abstract Only c39
Ya. V. Lyamin, R. A. Musin, and V. N. Ivanov *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 65 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 9, Sep. 1986 p 13-17 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

The influence of the ratio of the dimensions of welded joints on the distribution and magnitude of residual heat stresses was studied. It is assumed that the joint is in a linearly elastic state of planar deformation. The distribution of residual stresses in an uncompensated ceramic-metal joint is found to be significantly influenced by the ratio of the thicknesses of the welded materials and the relative thickness of the entire joint. The end zones in which stresses are concentrated to levels which are dangerous for fracture vary in size as a function of the ratio of thicknesses, encompassing the entire length, if the thicknesses are greater than actual stresses due to partial stress relaxation upon cooling. Author

N88-11800# Joint Publications Research Service, Arlington, Va.
OPERATION OF MULTISTAGE POWER SUPPLIES FOR ELECTRON BEAM WELDING INSTALLATIONS Abstract Only c37
G. I. Leskov and G. A. Loskutov *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 66 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 9, Sep. 1986 p 40-42, 62 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

Previous studies have analyzed multistage combined systems of rectifiers with parallel supply of primary windings of transformers of the stages assuming equality of active and reactive impedances. In transformers with isolated core with series power supply of transformers these conditions are not observed. An additional analysis is performed of the operation of these devices together with the rectifier stages. The difference in amplitude and phase shift of the currents in the stages is considered. Due to the phase shift of the currents in the stages, the maximum voltage across the load is decreased, as is its pulsation factor. Author

N88-11801# Hanford Engineering Development Lab., Richland, Wash.
LOW ACTIVATION FERRITIC ALLOYS FOR NUCLEAR FUSION REACTORS
D. S. Gelles Jan. 1987 21 p Presented at the American Institute of Metallurgical Engineers Annual Meeting: Light Metals Session, Denver, Colo., 22 Feb. 1987
(Contract DE-AC06-76FF-02170)
(DE87-010711; HEDL-SA-3379; CONF-870272-7) Avail: NTIS HC A03/MF A01

The fusion power reactor concept has an inherent advantage over fission reactor designs; the radioactivity of the fuel decays

rapidly with time. However, this inherent advantage will be lost unless reactor structural materials can be employed which have similar advantages. Elemental additions of Nb, Mo, Ni, and N have half lives which will lead to high levels of radioactivity even after 100 years of storage. Therefore, the Office of Fusion Energy, DOE has funded development of low activation alloys, i.e., alloys with very limited additions of Nb, Mo, Ni and N. This paper describes the design and testing of one series of alloys from one of the classes of materials being studied. The alloys are bainitic or martensitic stainless steels which have tungsten and/or vanadium substituted for molybdenum. Alloy selection criterion, production and testing will be described including microstructural examination and mechanical properties testing following irradiation by fast neutrons in a liquid metal cooled fast breeder reactor. The results demonstrate that martensitic stainless steels in the Fe-9 to 12 Cr range appear most promising for fusion structural materials applications. DOE

N88-11802*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CORROSION-RESISTANT AMORPHOUS METALLIC COATINGS: ENGINEERING DEVELOPMENT Progress Report, 1 Oct. 1985 - 1 Oct. 1986
D. J. Fitzgerald, S. DiStefano, and R. Rameshan Dec. 1986 54 p
(Contracts JPL-D-4549; DE-AI07-80ID-12138)
(NASA-CR-181487; NAS 1.26:181487; DE87-012744; DOE/ID-12138/6) Avail: NTIS HC A04/MF A01 CSCL 11F

The objective is to use sputter-deposited amorphous metallic coatings on alloys in heat recovery systems in power plants. It was found that chromium could be used as a substitute for ruthenium in MoRuB. The new alloy, MoCrB, has corrosion current two orders of magnitude lower than MoRuB. The effort to develop the parameters for depositing FeCrPC on steel was frustrated by a persistent pinhole problem. Two titanium-based alloys were developed which are equal to or better than the optimized FeCrPC alloy in terms of corrosion resistance. The potentiodynamic polarization characteristics of MoCrB and TiCrBC were measured over a range in temperature from 25 to 100 C. The corrosion current increased with temperature as predicted by theory. The corrosion characteristics of MoCrB and TiCrPC were also tested in 1.0N HCl. Cost analysis of the magnetron sputtering coating process indicates that the process cost is in the range of $2.50 to $3.00 per square foot steel. DOE

N88-11803# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
INVESTIGATIONS OF CREEP CAVITATION IN TYPE 304 STAINLESS STEEL Final Report, 8 May 1984 - 11 Nov. 1986
T. J. Delph 1987 10 p
(Contract DE-FG02-84ER-45088)
(DE87-014198; DOE/ER-45088/T2) Avail: NTIS HC A02/MF A01

An experimental technique involving the use of image analyzing computers to count and measure creep cavitation on polished metal surfaces has been developed. This technique has been applied to creep cavitation in the neighborhood of stress concentrations and in uniaxial tension specimens. Measurements made in uniaxial tensions have yielded considerable information about the statistical nature of cavitation, and have allowed detailed quantitative comparisons to be drawn with the predictions of analytical cavity growth models. A parallel modeling effort designed to include probabilistic features into analytical cavity growth models has resulted in a model which reproduces, at least in a qualitative sense, a number of the statistical features observed in experimental cavity growth and creep rupture data. Work along these lines is now being continued under a grant from the National Science Foundation. DOE

N88-11804# Brookhaven National Lab., Upton, N. Y.
MODELLING AND THEORIES OF ALLOY PHASE BEHAVIOR
R. E. Watson, J. W. Davenport, M. Weinert, and L. H. Bennett 1987 28 p Presented at the Thermochemistry of Alloys Conference, Kiel, Fed. Republic of Germany, 1 Aug. 1987 Prepared in cooperation with National Bureau of Standards, Washington, D.C.
(Contract DE-AC02-76CH-00016)
(DE87-014399; BNL-40178; CONF-8708125-1) Avail: NTIS HC A03/MF A01

Many trends in alloy phase formation are readily understood in terms of physically plausible atomic parameters. This has led to the introduction of structural maps where two (or more) such atomic parameters are employed as the coordinates and well-defined regions are observed to be associated with particular crystalline phases. These coordinates sometimes involve the difference in atomic parameters and sometimes involve an average. An alternative approach to the emphasis on atomic parameters has been the consideration of how atoms are packed in some crystal structure and how this controls what the constituent atoms may be. Recently this has led to the utilization of Wigner-Seitz (sometimes called Voronoi or Dirichlet) constructs of the atomic cells in a crystal structure and to the observation that sometimes two crystals which are nominally considered to have the same crystal structure according to normal crystallographic designation should be considered to be different. The Wigner-Seitz cell constructs have also offered a framework for understanding trends in the magnetic and chemical properties of particular phases as well as making coordination between crystalline and glassy structures. Neither of the above approaches provides numerical estimates of quantities of thermodynamic interest such as heats of formation. DOE

N88-11805# Rochester Univ., N. Y. Lab. for Laser Energetics.
NEAR-INFRARED DICHROISM OF A MESOGENIC TRANSITION METAL COMPLEX AND ITS SOLUBILITY IN NEMATIC HOSTS
K. L. Marshall and S. D. Jacobs 1987 25 p
(Contract DE-FC08-85DP-40200)
(DE87-014471; DOE/DP-40200/61) Avail: NTIS HC A03/MF A01

A transition metal complex possessing the nematic phase, bis (p-n-butylstyryl-1, 2-dithiolato) nickel, was synthesized and its optical properties and solubility in the nematic hosts K15 and MBBA were investigated. The metal complex displayed a high solubility in both host materials (up to 10% wt/wt) and a strong near-infrared absorption band centered at 860 nm. A blocking extinction of greater than OD = 3 was obtained with a 100 micron pathlength of a 0.5% wt/wt mixture of the nematic metal complex in K15, suggesting its usefulness for passive blocking of near infrared radiation. A 24 micron thick, homogeneously aligned guest-host cell containing a 1% wt/wt mixture of the metal complex in K15 possessed a contrast ratio of nearly 5:1 and a blocking extinction of OD = 3.5 at 860 nm, demonstrating for the first time the existence of near-infrared dichroism in this class of materials. The solubility and blocking extinction of the mesogenic metal complex in K15 was considerably superior to the non-mesogenic near ir laser dye bis(dimethylaminodithiobenzil) nickel in the same host. An interaction of the nematic metal complex in mixtures with MBBA which resulted in the creation of a new absorption band at 1050 nm was also observed. DOE

N88-11806# California Univ., Berkeley. Lawrence Berkeley Lab.
FACTORS DETERMINING THE MORPHOLOGY OF PRECIPITATION IN ALUMINUM-GERMANIUM AND ALUMINUM-SILICON ALLOYS
K. H. Westmacott and U. Dahmen Jul. 1987 21 p Presented at the 2nd International Conference on Phase Transformations in Solids, Cambridge, United Kingdom, 6 Jul. 1987
(Contract DE-AC03-76SF-00098)
(DE87-014682; LBL-23810; CONF-870719-4) Avail: NTIS HC A03/MF A01

HVEM in-situ studies of precipitation in Al-Si and Al-Ge alloys complemented by high resolution observations have provided a clear picture of the fundamental nucleation and growth processes. A model for the role of vacancies in precipitate growth was in general agreement with a dynamic sequence recording the loss

of coherency during plate growth. High resolution images obtained on the NCEM's Atomic Resolution Microscope provided direct information of precipitate/matrix interface structure, internal precipitate structure and orientation relationships. Based on the observations, simple model nuclei for various morphologies are proposed. These suggest that variations in the absolute and local vacancy supersaturation give rise to the precipitate patterns observed. DOE

N88-11807# Los Alamos National Lab., N. Mex.
BIRCH'S LAW AND THE PROPERTIES OF HIGH TEMPERATURE FLUID METALS
J. W. Shaner 1987 7 p Presented at the EHPRG Conference, Potsdam, German Democratic Republic, 25 Aug. 1987
(Contract W-7405-eng-36)
(DE87-014744; LA-UR-87-2921; CONF-8708131-1) Avail: NTIS HC A02/MF A01

By comparing acoustic velocities in fluid metals over a very wide range of densities Birch's Law has been established as an approximate representation over the entire liquid range. For a given liquid metal the acoustic velocity is close to linear in density, with a slope determined by the atomic weight. The measurements include isobaric expansion to less than half normal density, ultrasonics on molten metals at 1 atmosphere, and shock-melted metals to greater than twice normal density. Unusual behavior of the Gruneisen gamma is also found, which can be explained in terms of simple fluid models. DOE

N88-11808# Auburn Univ., Ala. Materials Engineering.
THE EFFECT OF STRAIN RATE ON THE YIELD BEHAVIOR OF IRON-BASE LRO ALLOYS AT ELEVATED TEMPERATURES
H. T. Lin, R. C. Wilcox, and B. A. Chin 1987 7 p
(Contract DE-FG05-86ER-52139)
(DE87-014893; DOE/ER-52139/1) Avail: NTIS HC A02/MF A01

The sensitivity of iron-base long-range ordered (LRO) alloys to strain rate at elevated temperatures was investigated. The tensile results indicate that the iron-base LRO alloys exhibit a positive temperature dependence of yield behavior, but are insensitive to variations in strain rate between 10 to the -5 and 10/sec. These observations, along with SEM and TEM results, suggest that previously proposed diffusion-controlled mechanisms are not responsible for the increase in yield strength with increasing temperature. DOE

N88-11809# Virginia Univ., Charlottesville. Dept. of Materials Science.
MICROSTRUCTURAL EFFECTS ON THE FATIGUE BEHAVIOR OF Fe-C-X ALLOYS Technical Progress Report, 16 Nov. 1984 - 15 Nov. 1987
G. J. Shiflet Sep. 1987 6 p
(Contract DE-FG05-85ER-45181)
(DE88-000155; DOE/ER-45181/4; UVA-527335/MS88/101)
Avail: NTIS HC A02/MF A01

The purpose of the original project was to obtain a better understanding of the role of various microstructural features on the strength and fatigue behavior of low alloy steels. The program investigated fatigue properties of steels by systematically controlling the microstructure through heat treatments. Three ternary steels were examined: Fe-C-Mn, Fe-C-V, and Fe-C-Mo. DOE

N88-11810# Lawrence Livermore National Lab., Calif.
SHOCK-INDUCED MELTING AND RAPID SOLIDIFICATION
W. J. Nellis, W. H. Gourdin, and M. B. Maple (California Univ., San Diego, La Jolla.) Aug. 1987 5 p Presented at the 5th Topical Conference of the American Physical Society on Shockwaves in Condensed Matter, Monterey, Calif., 20-23 Jul. 1987
(Contracts W-7405-eng-48; DE-FG03-86ER-45230)
(DE88-000226; UCRL-96769; CONF-870753-76) Avail: NTIS HC A02/MF A01

Model calculations are presented to estimate that approx. 50 GPa is required to completely shock melt metal powders with quenching at rates up to 10 K/s. Experiments are discussed for powders of a Cu-Zr alloy compacted in the usual way at 16 GPa and melted by shocking to 60 GPa. DOE

N88-11811# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkstoffe.
QUANTITATIVE ELECTRON PROBE MICROANALYSIS INVESTIGATION OF THE OXIDATION OF HIGH TEMPERATURE ALLOYS AT LOW OXYGEN PARTIAL PRESSURES Thesis - Technische Hochschule
L. A. MaldonadoLopez, H. Gruebmeier, A. Naoumidis, and H. Nickel Mar. 1987 175 p In GERMAN; ENGLISH summary
(JUEL-2120; ISSN-0366-0885; ETN-87-90589) Avail: NTIS HC A08/MF A01

The oxidation of two heat resistant alloys (Alloy 617 and Alloy 800H) was investigated using electron probe microanalysis techniques. Particular attention was paid to the determination of quantitative data for the oxide scale formed at the surface, the analysis of impurities in the scale, and the depletion effects in the matrix just below the scale. Specimens were exposed in the temperature range between 800 and 950C, and at oxygen partial pressures between 10 to the -16 to -19 power. The oxide scale formed on Alloy 800H consists of 2 layers, that on Alloy 617 of a single phase. The mass flow at the surface was determined, and then incorporated as a boundary condition in a diffusion program for the calculation of the concentration profile and the derivation of diffusion coefficients of Cr, Mn and Ti, in good agreement with data from the literature. ESA

N88-11812# Technische Hochschule, Aachen (West Germany). Fakultaet fuer Bergbau, Huettenwesen und Geowissenschaften.
INVESTIGATION OF THE DEFORMATION BEHAVIOR OF FERRITIC TWO-PHASE Fe-Ni-Al ALLOYS WITH HIGH CONCENTRATIONS OF THE INTERMETALLIC (Fe, Ni)Al PHASE AT HIGH TEMPERATURES Ph.D. Thesis [UNTERSUCHUNG DES VERFORMUNGSVERHALTENS FERRITISCHER ZWEIPHASIGER FE-NI-AL-LEGIERUNGEN MIT GROSSEN ANTEILEN DER INTERMETALLISCHEN (FE, NI)AL-PHASE BEI HOHEN TEMPERATUREN]
Ingrid Jung 1986 125 p In GERMAN Sponsored by the Bundesministerium fuer Forschung und Technologie, Fed. Republic of Germany
(ETN-87-90605) Avail: NTIS HC A06/MF A01

Ferritic model alloys were investigated to extend the application domain of ferritic, heat resistant steels to higher temperatures. The dependence of the deformation behavior, especially of the creep behavior on structure, stress and temperature was determined by tests and the results serve as a basis for the development of heat resistant alloys. The creep behavior is quantitatively described using a developed creep model. The creep of alloys with low precipitation concentrations (up to 20 vol %) is mainly determined by displacement creep. At higher concentrations the grain deformation and hence the displacement creep are strongly hindered. Deformation charts, calculated on the basis of the obtained results, allow a prediction of the deformation long term behavior, where diffusion creep processes have a special significance. ESA

N88-11813# Technische Hochschule, Aachen (West Germany). Fakultaet fuer Bergbau, Huettenwesen und Geowissenschaften.
INVESTIGATION OF CREEP CRACK GROWTH IN HEAT RESISTANT TUBE STEELS Ph.D. Thesis [UNTERSUCHUNG DES KREIECHRISSWACHSTUMS IN WARMFESTEN ROEHRENSTAEHLEN]
Volker Detampel 1987 97 p In GERMAN
(ETN-87-90606) Avail: NTIS HC A05/MF A01

Creep crack growth in tube steels was investigated using 14 MoV 6 3 and 10 Cr Mo 9 10, emphasizing the load parameter C*. The status of knowledge in the fields of empirical load parameter choice, specific materials behavior, continuum mechanics, and creep crack growth models is reviewed. The creep

crack growth in steady state is qualitatively described. A prediction of the crack evolution and hence of the lifetime seems possible with conservative assumptions. A comparative life time estimate is proposed. The parameters which affect the creep crack growth are discussed. The creep crack growth micromechanism is explained. ESA

N88-11814# Technische Univ., Hanover (West Germany). Fachbereich Physik.
KINETICS OF CO ADSORPTION ON NICKEL USING TIME RESOLVED VIBRATION SPECTROSCOPY Ph.D. Thesis [KINETIK DER CO-ADSORPTION AUF NICKEL MIT ZEITAUFGELOESTER VIBRATIONSSPEKTROSKOPIE]
Ulrich Koehler 1986 130 p In GERMAN
(ETN-87-90615) Avail: Issuing Activity

Time resolved electron energy loss spectroscopy (EELS) with a pulsed or continuous molecular beam was used to investigate the adsorption system CO on Ni(111). The kinetics data of the system in the temperature range between minus 150 and 200 C were directly obtained from the time variation of the EEL spectra in the adsorption and desorption phase. It is found that CO adsorbs linearly on the Ni surface, in double and single coordination, and that for coverages greater than 0.5 at temperatures greater than minus 30 C a finite desorption probability exists. The desorption energy and preexponential factor were determined for different global coverages. During variation of the sample temperature at constant coverage an equilibrium distribution of the occupation of both adsorbates is created. ESA

N88-11815# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain). Seccion de Materiales Estructurales.
STUDY OF STAINLESS STEEL TIME-TEMPERATURE SENSITIZATION DIAGRAMS, PART 1 [ESTUDIO DE LOS DIAGRAMAS TEMPERATURA TIEMPO SENSIBILIZACION DE LOS ACEROS INOXIDABLES, PARTE 1]
E. AsensiAlvarez-Arenas, C. Rodriguez-Augustin, and D. deRuedalbanez 1987 11 p In SPANISH; ENGLISH summary
(ETN-87-90762) Avail: NTIS HC A03/MF A01

The precipitation of M23C6 at grain boundaries and the suceptibility to intergranular corrosion of different heats of AISI 304 (C=0.097) was evaluated, deriving time temperature sensitization by 4 different methods, including ASTM practices and methods based on conventional microscopy and interference contrast. The high temperature carbide solution process is recorded in a photographic sequence. The time-temperature-precipitation diagrams are obtained. ESA

N88-11816# Inco Europe Ltd., Birmingham (England). Alloy Products Div.
CREVICE CORROSION OF STAINLESS STEELS AND RELATED ALLOYS. PART 2: SUMMARY OF EXPERIMENTAL TEST DATA FOR INPUT TO MATHEMATICAL MODEL Final Report
J. W. Oldfield 24 Jun. 1986 55 p
(Contract NCS-324/1702)
(BR99871-Pt-2; ETN-87-90990) Avail: NTIS HC A04/MF A01

Tests were carried out to develop isocorrosion data for Type 316 stainless steel and alloy 904L (20Cr-25Ni-4.5Mo-1.5Cu). The oxygen reduction and hydrogen evolution reactions were studied to examine their role in the process of crevice corrosion, and differences between natural seawater and two forms of synthetic seawater were examined. In the active potentional region corrosion rates of Type 316 steel and alloy 904L increase with falling pH. All corrosion rates are less than 1mm/y. Diffusion and activation controlled oxygen reduction currents in natural seawater increase with increased pre-exposure times. In synthetic seawater the diffusion limited current remains unchanged while the activation controlled current falls with increase in pre-exposure time. ESA

N88-11817*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WEAR OF IRON AND NICKEL IN CORROSIVE LIQUID ENVIRONMENTS
Kazuhisa Miyoshi and George W. P. Rengstorff (Toledo Univ., Ohio.) 1987 20 p Proposed for presentation at Corrosion '88, St. Louis, Mo., 21-25 Mar. 1988; sponsored by the National Association of Corrosion Engineers
(NASA-TM-100246; E-3861; NAS 1.15:100246) Avail: NTIS HC A03/MF A01 CSCL 11F

Friction and wear behavior of Fe and Ni sliding on aluminum oxide in aerated sulfuric acid and hydrochloric acid were investigated. The results show that the concentration of acid is an important factor in controlling the metal loss caused by wear corrosion processes in the acids. At very dilute acid concentration (10 to the -4 N), Fe behaves differently from Ni. Fe develops a soft, friable deposit, while Ni develops no corrosion layer. The formation and removal of the corrosion deposit on Fe resulted in high metal loss and coefficient of friction, as compared to the relatively low metal loss and coefficient of friction observed for Ni. At slightly higher acid concentration (10 to the -3 and 10 to the -2 N), no corrosion products were produced on both Fe and Ni. Wear of Fe and Ni was generally at a minimum. At higher acid concentration (10 to the -1 N and above), loss of Fe and Ni increased as the acid concentration increased. In sulfuric acid the maximum loss of both Fe and Ni was at 7.5 N (30%) concentration, and the metal losses of both Fe and Ni dropped markedly at 15 N (50%) and above. In hydrochloric acid, however, the Fe loss continued to increase with the increase of acid concentration, and the maximum Fe loss occurred in the most concentrated acid (12.1 N, 37%). There were variations in loss with Ni from specimen to specimen examined in hydrochloric acids (10 to the -1 N and above). The coefficient of friction for Ni increased slightly with an increase in acid concentration up to 10 to the -2 N. When corrosion started to dominate in the wear-corrosion process, the coefficient of friction decreased in both sulfuric and hydrochloric acids at 10 to the -1 N and above. Author

N88-11818 Lehigh Univ., Bethlehem, Pa.
STRESS CORROSION CRACKING OF HIGH-STRENGTH STEELS IN AQUEOUS ENVIRONMENTS Ph.D. Thesis
Hsi-Cheng Chu 1987 151 p
Avail: Univ. Microfilms Order No. DA8714660

The objective was to determine whether electrochemical reactions controlled crack growth in aqueous environments. Stress corrosion cracking behavior of AISI 4130 and AISI 4340 steels was studied as a function of temperature in deaerated pure water, and in deaerated sodium chloride and sodium carbonate-bicarbonate solutions. Particular attention was given to the k-dependent crack growth rate. Companion measurements of the rates of electrochemical reactions on bare steel surfaces were also made as a function of temperature in the chloride and carbonate-bicarbonate solutions, using an in-situ fracture technique to generate the bare surfaces. The results show that crack growth was thermally activated in all three solutions. Crack growth rate was found to be the most rapid pure water, followed by sodium chloride and then sodium carbonate-bicarbonate. Of the reactions, anodic dissolution, hydrolysis, and cathodic reduction of hydrogen, it appears that the hydrolysis reactions are the slowest and are rate limiting. In addition, the results showed the influence of microstructure and the role of ionic transport in determining the crack tip chemistry. These influences on crack growth response are discussed, and areas for further research are described.
Dissert. Abstr.

N88-11819 Drexel Univ., Philadelphia, Pa.
A FUNDAMENTAL STUDY OF THE MECHANICAL AND MICRO-STRUCTURAL RESPONSE OF ELEVATED TEMPERATURE PM ALUMINUM-TITANIUM ALLOYS Ph.D. Thesis
Thesis
William Edward Frazier 1987 232 p
Avail: Univ. Microfilms Order No. DA8716196

In order to extend the useful range of temperature of aluminum alloys to 200 to 300 C, a novel processing scheme was formulated where prealloyed gas atomized powders were mechanically alloyed in the presence of a carbon bearing process control agent to produce an alloy with a fine dispersion of aluminides, carbides and oxides. Titanium was selected as the prime alloying element

since it forms a thermally stable Al sub 3 Ti dispersoid and has the potential to form a stable carbide, i.e., TiC. The objective of the study was to investigate the microstructural and mechanical behavior and develop a model to account for the ambient and elevated temperature deformation behavior. Dissert. Abstr.

N88-11820# Johns Hopkins Univ., Baltimore, Md.
ULTRA-FINE GRAINED ALLOY MATERIAL
James D. Clark and Paul Kelley Jun. 1987 50 p Sponsored by Army Ballistic Research Lab., Aberdeen Proving Ground, Md.
(AD-A184500; BRL-CR-573) Avail: NTIS HC A03/MF A01 CSCL 11F

Thermomechanical processing has been applied to selected alloys to produce enhanced ductility. A fine-grained microstructure at high ductility was produced in eutectic lead-tin and lead-antimony. Melt-extracted fibers of lead-antimony were also produced and exhibited high ductility. Microstructural analyses were performed using optical and X-ray methods. It was concluded that ductility enhancement was due to the presence of large quantities of metastable, disordered grain boundary material. GRA

N88-11821# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
A THEORETICAL ANALYSIS OF THE DEACTIVATION OF METAL SURFACES UPON CARBURIZATION
S. A. Jansen and R. Hoffman Jul. 1987 7 p
(Contract N00014-82-K-0576)
(AD-A184556; TR-33) Avail: NTIS HC A02/MF A01 CSCL 11F

The catalytic activity of transition metal surfaces can be altered significantly by the deposition of carbon adlayers. In the case of nickel surfaces, several catalytic processes are enhanced. For the case of tungsten, a reconstruction occurs and the resultant surface activity is associated with both structural and electronic changes induced by the deposition of carbon. Recent experimental studies on transition metal carbides and carburized transition metals have suggested that the carbon, either present in the bulk or exposed at the surface, affects the adsorption properties of simple gaseous adsorbates. GRA

N88-11822# Florida Univ., Gainesville.
INTERNATIONAL CONFERENCE ON MICROSTRUCTOLOGY HELD IN GAINESVILLE, FLORIDA ON 7-9 MAY 1986 Final Report, 6 May 1986 - 5 May 1987
R. T. DeHoff May 1987 66 p Conference held in Gainesville, Fla., 7-9 May 1986
(Grant DAAL03-86-G-0094)
(AD-A184604; ARO-23870.1-MS-CF) Avail: NTIS HC A04/MF A01 CSCL 11F

Microstructology is the science of the realistic and precise correlation of microstructure with the physical properties and processes of materials. Real microstructure of materials are always irregular in the sense that no two grains, or particles, in the structure are alike in size, shape or arrangement in space. Despite this irregularity, all of the parts fit together to form a continuous structure. Microstructology characterizes such structures by the exclusive use of the global parameters of geometry, some of which are drawn from the fields of Stereology. No geometric assumptions of any kind are permitted. The relationships and mechanisms are deduced rather than postulated. These are all revealed as a product of structural characterization in the course of physical change. GRA

N88-11823# Colorado School of Mines, Golden. Center for Welding Research.
THE INFILTRATION KINETICS OF ALUMINUM IN SILICON CARBIDE COMPACTS Annual Report
Glen R. Edwards and David L. Olson Jul. 1987 44 p
(Contract N00014-85-K-0451)
(AD-A184682; MT-CWR-087-032) Avail: NTIS HC A03/MF A01 CSCL 11D

Although metal matrix composites have been fabricated by various techniques, the most successful are solid state processes such as powder metallurgy and diffusion bonding. Liquid metal processes such as compucasting, pultrusion, and infiltration, while less successful, are potentially more economical. The advantages of producing silicon carbide-aluminum matrix composites by liquid metal infiltration techniques can not be fully realized without an improved understanding of the infiltration behavior and the fiber/matrix bonding mechanisms. This paper reports on infiltration models which consider the physical properties of the liquid and preform (either porous compact or capillary/tube bundle). These properties include viscosity, density, surface tension, and wettability (pore shape and size in the case of the porous compact). The models have been assessed in terms of their ability to predict infiltration behavior from known physical properties of the materials. GRA

N88-11824# Oak Ridge National Lab., Tenn.
EFFECT OF HELIUM ON IRRADIATION CREEP IN AN AUSTENITIC STAINLESS STEEL
M. L. Grossbeck and J. A. Horak 1987 6 p Presented at the Joint Meeting of the American Nuclear Society and the Atomic Industrial Forum, Los Angeles, Calif., 15 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE87-013754; CONF-871101-58) Avail: NTIS HC A02/MF A01

The first wall of a fusion reactor will be subjected to a flux of high energy neutrons which will result in the formation of atomic displacements and their associated phenomena, coupled with the formation of helium via (n,α) reactions. The purpose of the experiments described here is to determine the irradiation creep properties of several austenitic stainless steels under irradiation conditions simulating fusion reactor conditions in terms of both damage rate and helium generation rate (He:dpa ratio). DOE

N88-11825# Oak Ridge National Lab., Tenn.
MODIFIED 14Cr-16Ni STAINLESS STEELS WITH IMPROVED CREEP RESISTANCE AT 700 C DUE TO TAILORED PRECIPITATE MICROSTRUCTURES
P. J. Maziasz and R. W. Swindeman Sep. 1987 9 p Presented at the International Conference on Advances in Material Technology for Fossil Power Plants, Chicago, Ill., 1 Sep. 1987
(Contract DE-AC05-84OR-21400)
(DE87-014788; CONF-870980-1) Avail: NTIS HC A02

The compositions of several 14Cr-16Ni (2.5Mo,2Mn) austenitic stainless steels were modified with combinations of minor and residual alloying elements to produce excellent creep strength based on unique precipitate microstructures. These modifications produce fine MC and FeTiP precipitate particles in the matrix for strength, and combinations of coarser M23C6, M6C, and MC, particles along the grain boundaries for improved ductility and rupture resistance. The creep-rupture resistance of these modified 14 to 16 steels is superior to that of type 316 or alloy 800H and better than that of 17 to 14CuMo at 700 C in the mill-annealed condition. These new steels approach the creep resistance of alloy 617 at 700 to 760 C. Analysis of microstructure and correlation with creep properties suggests that precipitate effects are primarily responsible for the improvement in mechanical properties. The design of the novel precipitate microstructures is based on microcompositional information obtained using state-of-the-art analytical electron microscopy (AEM). DOE

N88-11826# Oak Ridge National Lab., Tenn.
REDUCED-ACTIVATION FERRITIC STEELS: A COMPARISON WITH Cr-Mo STEELS
R. L. Klueh and P. J. Maziasz 1987 19 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-000332; CONF-871036-4) Avail: NTIS HC A03/MF A01

Reduced-activation ferritic steels are being developed to replace the Cr-Mo steels presently being considered for fusion-reactor applications. To meet the reduced-activation criteria, the steels cannot contain Mo, Nb, Ni, Cu, and N. Tungsten is proposed as a substitute for molybdenum and niobium is replaced by tantalum

and an increased use of vanadium. An initial series of Cr-W steels have been produced that are analogous to the Cr-Mo steels. Microstructural examination, tempering studies, tensile tests, and Charpy impact tests indicate that three Cr-W steels with 9 to 12 percent Cr are comparable to the 9Cr-1MoVNb and 12Cr-1MoVW steels, which are presently the primary candidate ferritic steels for fusion applications. DOE

N88-11827# Oak Ridge National Lab., Tenn.
IMPACT BEHAVIOR OF 9-Cr AND 12-Cr FERRITIC STEELS AFTER LOW-TEMPERATURE IRRADIATION
R. L. Klueh, J. M. Vitek, W. R. Corwin, and D. J. Alexander 1987 15 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-000333; CONF-871036-3) Avail: NTIS HC A03/MF A01

Miniature Charpy impact specimens of 9Cr-1MoVNb and 12Cr-1MoVW steels and these steels with 1 and 2 percent Ni were irradiated in the High-Flux Isotope Reactor (HFIR) at 50 C to displacement damage levels of up to 9 dpa. Nickel was added to study the effect of transmutation helium. Irradiation caused an increase in the ductile-brittle transition temperature (DBTT). The 9Cr-1MoVNb steels, with and without nickel, showed a larger shift than the 12Cr-1MoVW steels, with and without nickel. The results indicated that helium also increased the DBTT. The same steels were previously irradiated at higher temperatures. From the present and past tests, the effect of irradiation temperature on the DBTT behavior can be evaluated. For the 9Cr-1MoVNb steel, there is a continuous decrease in the magnitude of the DBTT increase up to an irradiation temperature of about 400 C, after which the shift drops rapidly to zero at about 450 C. The DBTT of the 12Cr-1MoVW steel shows a maximum increase at an irradiation temperature of about 400 C and less of an increase at either higher or lower irradiation temperatures. DOE

N88-11828# Oak Ridge National Lab., Tenn.
MICROSTRUCTURAL CHARACTERIZATION OF IRRADIATED PWR STEELS USING THE ATOM PROBE FIELD-ION MICROSCOPE
M. K. Miller and M. G. Burke Aug. 1987 8 p Presented at the 3rd International Symposium on Environmental Degradation of Materials in Nuclear Power Systems: Water Reactors, Traverse City, Mich., 30 Aug. 1987 Prepared in cooperation with Pittsburgh Univ., Pa.
(Contract DE-AC05-84OR-21400)
(DE88-000341; CONF-870839-4) Avail: NTIS HC A02

Atom probe field-ion microscopy has been used to characterize the microstructure of a neutron-irradiated A533B pressure vessel steel weld. The atomic spatial resolution of this technique permits a complete structural and chemical description of the ultra-fine features that control the mechanical properties to be made. A variety of fine scale features including roughly spherical copper precipitates and clusters, spherical and rod-shaped molybdenum carbide and disc-shaped molybdenum nitride precipitates were observed to be inhomogeneously distributed in the ferrite. The copper content of the ferrite was substantially reduced from the nominal level. A thin film of molybdenum carbides and nitrides was observed on grain boundaries in addition to a coarse copper-manganese precipitate. Substantial enrichment of manganese and nickel was detected at the copper-manganese precipitate-ferrite interface and this enrichment extended into the ferrite. Enrichment of nickel, manganese and phosphorus was also measured at grain boundaries. DOE

N88-11829# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
SURFACE CHEMISTRY OF TRANSITION METAL CARBIDES: A THEORETICAL ANALYSIS
Susan A. Jansen and Roald Hoffmann Jul. 1987 61 p
(Contract N00014-82-K-0576)
(AD-A184237; TR-34) Avail: NTIS HC A04/MF A01 CSCL 07D

Extended Huckel tight binding calculations have been employed to analyze the interactions of oxygen, carbon monoxide and methanol with the (100) and (111) faces of a representative rocksalt carbide, TiC. The (111) face have been experimentally shown to be the most active toward the adsorption, dissociation or decomposition of adsorbates, whereas the (100) face demonstrates very little activity. Calculations suggest that the differential reactivity of the two faces is the result of the coordination of the atom in the active site and the presence of surface carbon. For CO on the (100) the population of the 2Pi* level increases if carbon vacancies are included in the calculations and dissociated occurs. For the (111) metal-terminated face of TiC the population of the 2Pi* level is nearly identical to that calculated for Ti(0001). Methanol dissociates into methoxy and a protic species on the (111) face but remains molecular on the (100). The calculations suggest that the molecular species is stabilized by interaction of the methanolic proton with the surface carbon. GRA

N88-11876# Joint Publications Research Service, Arlington, Va.
STATUS OF TITANIUM ALLOYS R AND D DESCRIBED
Fanchang Ceng *In its* China report: Science and Technology 9 Apr. 1987 p 39-45 Transl. into ENGLISH from Guoji Hangkong (Beijing, Peoples Republic of China), no. 10, 5 Oct. 1986 p 8-11 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

N88-11877# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF BORON ON POROSITY IN NICKEL-BASE SUPERALLOY CASTINGS
Yaoxiao Zhu, Shunnan Zhang, Leying Xu, Yingjie Tong, Xiuzhen Ning, Zezhou Liu, Cuiping Hou, and Jing Bi *In its* China report: Science and Technology 9 Apr. 1987 p 46-54 Transl. into ENGLISH from Jinshu Xuebao (Beijing, Peoples Republic of China), v. 21, no. 1, 18 Feb. 1985 p A1-A8 Original language document was announced in IAA as A85-46812 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N88-11830*# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.
THE FRICTION AND WEAR OF TPS FIBERS Progress Report
W. D. Bascom and S. Wong Nov. 1987 14 p
(Grant NAG2-444)
(NASA-CR-181496; NAS 1.26:181496) Avail: NTIS HC A03/MF A01 CSCL 11B

The sliding friction behavior of single filaments of SiO2, SiC, and an aluminoborosilicate has been determined. These fibers are used in thermal protection systems (TPS) and are subject to damage during weaving and aero-maneuvering. All fibers exhibited stick-slip friction indicating the successive formation and rupture of strong junctions between the contacting filaments. The static frictional resistance of the sized SiC filament was 4X greater than for the same filament after heat cleaning. This result suggests that the sizing is an organic polymer with a high shear yield strength. Heat cleaning exposes the SiC surface and/or leaves an inorganic residue so that the adhesional contact between filaments has a low fracture energy and frictional sliding occurs by brittle fracture. The frictional resistances of the sized and heat cleaned SiO2 and glass filaments were all comparable to that of the heat cleaned SiC. It would appear that the sizings as well as the heat cleaned surfaces of the silica and glass have low fracture energies so that the sliding resistance is determined by brittle fracture.
Author

N88-11831*# Rutgers Univ., Camden, N.J. Dept. of Chemistry.
A QUANTUM THEORETICAL STUDY OF POLYIMIDES Final Report
Luke A. Burke 4 Dec. 1987 16 p
(Grant NAG1-434)
(NASA-CR-181495; NAS 1.26:181495) Avail: NTIS HC A03/MF A01 CSCL 11B

One of the most important contributions of theoretical chemistry is the correct prediction of properties of materials before any costly experimental work begins. This is especially true in the field of electrically conducting polymers. Development of the Valence Effective Hamiltonian (VEH) technique for the calculation of the band structure of polymers was initiated. The necessary VEH potentials were developed for the sulfur and oxygen atoms within the particular molecular environments and the explanation explored for the success of this approximate method in predicting the optical properties of conducting polymers. B.G.

N88-11832# Oak Ridge National Lab., Tenn.
NDE (NONDESTRUCTIVE EVALUATION) OF ADVANCED STRUCTURAL CERAMICS
W. A. Simpson, Jr. and R. W. McClung 1987 22 p Presented at the Conference on Nondestructive Testing of High Performance Ceramics, Boston, Mass., 25 Aug. 1987
(Contract DE-AC05-84OR-21400)
(DE87-014417; CONF-870856-2) Avail: NTIS HC A03/MF A01

We describe development of techniques for the evaluation of ceramics using high-frequency elastic waves to probe the region of interest. Flaws smaller than 25 microns have been detected in monolithic and composite ceramics at depths of about 3 mm in alumina, silicon carbide and silicon nitride, and about 5 mm in zirconia. Advanced procedures are described for the rapid determination of attenuation as a function of frequency for studies of microstructural variation. Both frequency dependent and independent corrections are made automatically to yield the true material attenuation. Whisker clumps in whisker-toughened ceramics were also detected and mapped, and the relatively large size of 100 to 200 micron diameter ensures that they will be detected reliably even when located relatively far from the transducer focal plane. DOE

N88-11833# Lawrence Livermore National Lab., Calif.
MODELING OF IRRADIATION-INDUCED AMORPHIZATION IN A TITANATE CERAMIC
W. A. Coghlan and F. W. Clinard, Jr. 1987 23 p Presented at the Conference on Solid State Amorphizing Transformation, Los Alamos, N. Mex., 10-13 Aug. 1987 Submitted for publication
(Contract W-7405-eng-36)
(DE87-014751; LA-UR-87-2873; CONF-8708104-3) Avail: NTIS HC A03/MF A01

Calculations have been carried out to model the alpha decay-induced conversion of a titanate ceramic ($CaPuTi_2O_7$) from the crystalline state to an amorphous condition. Experimental results have shown that the disordered state varies with irradiation temperature and extent of redamage, and so special consideration is given to those factors. Results of these calculations are applied to the analysis of dimensional changes during irradiation at various temperatures and release of stored energy on recovery to the crystalline state. Modeling results appear to show that it is possible to convert to the amorphous state under irradiation by two different processes. Modeling is also employed to extend experimental results on swelling from the present data base to a high damage rate characteristic of ion implantation and the low rates typical of nuclear waste storage and self-damage of natural mineral analogs. DOE

N88-11834 Deutsche Keramische Gesellschaft, Bad Honnef (West Germany).
CHARACTERIZATION AND THERMAL CONDUCTIVITY OF HOT-PRESSED SILICON CARBIDE [CHARAKTERISIERUNG UND WAERMELEITFAEHIGKEIT VON HEISSGEPRESSTEM SILICIUMKARBID]
R. Brandt and B. Schulz 1986 67 p In GERMAN
(DKG-25; ETN-87-90572) Copyright Avail: Issuing Activity

The correction between the characterization parameters, such as grain size and chemical composition, and the thermal conductivity of solid materials was studied, using silicon carbide. The materials selection, the production of SiC, and the manufacturing of samples are presented. The chemical analysis, the X ray fine-structure analysis, the metallographic examination of SiC, and the measurement of its thermal conductivity are explained. The observed strong scatter in the measured conductivity values due to measurement errors and scatter in the sample material is reduced at higher temperatures. The variation of a single materials parameter on the thermal conductivity was found to be impossible, since it leads simultaneously to changes in several other parameters. ESA

N88-11835# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
THE CORRELATION BETWEEN MICROSTRUCTURE AND THERMOMECHANICAL PROPERTIES OF TWO-PHASE MATERIALS AND POROUS SINTERED MATERIALS
G. Ondracek Mar. 1987 47 p In GERMAN; ENGLISH summary
(KfK-4205; ISSN-0303-4003; ETN-87-90587) Copyright Avail: NTIS HC A03/MF A01

The effects of the microstructure on the properties of multiphase and porous materials were investigated with a view to the tailoring of the materials. The theory of microstructure-property correlations, including the bound concept and the model concept, is described for thermal conductivity and modulus of elasticity. The determination of the microstructural factors by quantitative microstructural analysis is demonstrated. The equations were tested for engineering purposes by comparing measured and calculated property values for porous ceramics, graphite, metals, cermets, metal-polymer composites, and polymer-ceramic composites. The dependence of the thermal conductivity and the modulus of elasticity on the porosity were used to predict the thermal shock resistance of porous glass and to compare the results with experimental data. ESA

N88-11836# Technische Univ., Clausthal-Zellerfeld (West Germany). Fakultaet fuer Bergrau, Huettenwesen und Maschinenwesen.
THE BEHAVIOR OF PLASTIC, CERAMIC MASSES IN COMPRESSION TESTS Ph.D. Thesis [DAS VERHALTEN PLASTISCHER KERAMISCHER MASSEN IM KOMPRESSIONS-VERSUCH]
Gerd Hurias 1986 159 p In GERMAN; ENGLISH summary Sponsored by Arbeitsgemeinschaft Industrieller Forschung (AIF), Fed. Republic of Germany
(ETN-87-90603) Avail: NTIS HC A08/MF A01

A parallel-plate plastometer for the compression testing of ceramic bodies is presented. The upper plate of the machine is moved down with constant velocity by an electromotor. The compression is registered by an inductive displacement transducer and a load cell. The results of measurements on series of ceramic materials are shown as a function of deformation rate and moisture content. The stress-strain curves start with a steep increase of stress for small compression, going into a more flat increase, and end in a stress decrease which is interpreted as the development of slip planes, leading to cracks. All characteristic values decrease with increasing water content, except at the start of cracks. In general the required water content rises with the fineness of the material and the fraction of plastic components. ESA

N88-11837# Turbomeca S. A. - Brevets Szydlowski, Bordes (France).
HIGH TEMPERATURE CHARACTERIZATION OF CERAMIC MATERIALS Final Report [CARACTERISATION A HAUTE TEMPERATURE DE MATERIAUX CERAMIQUES]
D. Fournier 6 Feb. 1987 27 p In FRENCH
(Contract DRET-84-517)
(Rept-NT-3403; ETN-87-90903) Avail: NTIS HC A03/MF A01

The design and realization of very high temperature test machines, a characterization of SiC and SiAlON ceramics at 1200 C, and the study of fracture mechanisms are described. The implemented machines, such as oven and extensometer are described. It is found that while SiC keeps excellent mechanical properties at 1200 C, SiAlON ceramics behave poorly. Fracture is preceded by a measurable deformation, related to the generation of a glass phase. This change in microstructure is sufficient to explain the degradation of the mechanical properties. ESA

N88-11838*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRUCTURE AND GRAIN COARSENING DURING THE PROCESSING OF ENGINEERING CERAMICS Ph.D. Thesis - Leeds Univ., United Kingdom
Nancy J. Shaw Nov. 1987 178 p
(NASA-TM-100235; E-3860; NAS 1.15:100235) Avail: NTIS HC A09/MF A01 CSCL 11B

Studies have been made of three ceramic systems (Al2O3, Y2O3/MgO, and SiC/C/B), both to explore a surface area/density diagram approach to examining the coarsening processes during sintering and to explore an alternative coarsening parameter, i.e., the grain boundary surface area (raising it at a given value of the density) and not the pore surface area; therefore, pinning of the grain boundaries by solid-solution drag is the only function evidenced by these results. The importance of such pinning even at densities as low as 75% of theoretical is linked to the existence of microstructural inhomogeneities. The early stages of sintering of Y2O3 powder have been examined using two techniques, BET surface area analysis and transmission electron microscopy. Each has given some insight into the process occurring and, used together, have provided some indication of the effect of MgO on coarsening during sintering. Attempts to further elucidate effects of MgO on the coarsening behavior of Y2O3 by the surface area/density diagram approach were unsuccessful due to masking effects of contaminating reactions during sintering and/or thermal etching. The behavior of the undoped SiC which only coarsens can be clearly distinguished by the surface area/density diagram from that of SiC/C/B which also concurrently densifies. Little additional information was obtainable by this method due to unfavorable sample etching characteristics. The advantages, disadvantages, and difficulties of application of these techniques to the study of coarsening during sintering are discussed. Author

N88-11839# Dow Corning Corp., Midland, Mich.
INVESTIGATION OF STRUCTURE-PERMEABILITY RELATIONSHIPS OF SILICONE POLYMER MEMBRANES Final Report, Oct. 1982 - Sep. 1986
C. L. Lee, S. A. Stern, J. E. Mark, and Ed Hoffman Dec. 1986 671 p Prepared in cooperation with Syracuse Univ., N.Y., Cincinnati Univ., Ohio and Hoffman (Ed), Laramie, Wyo.
(Contract GRI-5082-260-0666)
(PB87-230181; GRI-87/0037) Avail: NTIS HC A99/MF A01 CSCL 11B

The structure-permeability relationships of silicone polymer membranes were investigated using three series of silicone polymers, i.e., (A) (R2SiO)x, (B) (Me2Si(CH2)ySiMe2O)x, and (C) (Me2Si-C6H4-SiMe2O)x and 14 gases, i.e., O2, N2, CO2, He, CH4, C2H6, C3H8, CH2=CH2, NH3, H2S, H2O, CO, H2 and COS. The polymers were synthesized and the key physical parameters pertinent to the gas permeability were determined. It was found that increasing bulkiness of the alkyl (R) group in Series A polymer and alkylene linkage in Series B polymer caused a marked decrease in the gas permeability but limited effect on the O2-N2 selectivity. The decrease in the gas permeability was due mainly to the decrease in the diffusivity of the penetrant. The selectivity of the highly permeable silicone polymer depends mostly on the solubility ratio. As the permeability decreases, the contribution of diffusivity ratio also becomes significant. The solubility coefficient of a gas in a given silicone polymer at temperature (T) can be correlated to the critical temperature (Tc) of gas by a + b(Tc/T)2, but no simple relation is available for a given gas in different polymers. GRA

N88-11840# Massachusetts Inst. of Tech., Cambridge.
PRECISE MEASUREMENT OF REFRACTIVE INDEX AND ABSORPTION COEFFICIENT OF NEAR MILLIMETER WAVE AND FAR INFRARED MATERIALS Final Report, 1 Feb. 1984 - 31 Jan. 1987
Mohammed N. Afsar and Kenneth J. Button Jun. 1987 9 p
(Contract DAAG29-84-K-0023)
(AD-A184538; ARO-20748.1-PH) Avail: NTIS HC A02/MF A01 CSCL 20F

A quasi-optical technique, namely, dispersive Fourier transform spectrometry, has now been improved to provide high-precision continuous data of complex refractive index, complex dielectric permittivity and loss tangent of materials and complex magnetic permeability of ferrite materials at millimeter and submillimeter wavelengths. The use of a polarizing two beam interferometric technique allowed a broad frequency coverage in particularly between 6mm and 0.5mm range. Non-polar polymers such as polyethylene and teflon exhibit extremely low-loss characteristics in the entire millimeter wavelength range. GRA

N88-11841# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Physics.
ION-MATRIX COUPLING IN POLYMER ELECTROLYTES FROM RELAXATION TIME STUDIES Final Technical Report, 1 Feb. - 4 Aug. 1987
L. M. Torell and C. A. Angell (Purdue Univ., West Lafayette, Ind.) 4 Aug. 1987 22 p Submitted for publication
(Contract N00014-84-K-0289)
(AD-A184632; TR-13) Avail: NTIS HC A03/MF A01 CSCL 07D

We review the effects of temperature on conductance and viscosity in the liquid state of vitreous ionic conductors and show how differences may be best understood by comparison of relaxation times for electrical and mechanical stresses acting on liquid or glassy states of the material. This leads to the definition of a conductivity/viscosity mode decoupling index, useful as a figure of merit for the solid electrolyte. In applying the same approach to polymer electrolyte systems a problem is encountered due to the molecular weight dependence of the viscosity. This is resolved by deriving a monomer shear relaxation time for the polymer electrolyte solution and showing that this quantity corresponds closely with the local mechanical relaxation time obtained from light scattering studies (which is a molecular weight independent quantity for pure polymers). Comparison of the electrical relaxation times of the polymer solution with the local (or matrix) relaxation times then shows that the relationship found for supersonic glassforming systems is inverted in the case of polymer electrolytes. GRA

N88-11842# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-MOLECULAR COMPOUNDS (SELECTED ARTICLES)
24 Aug. 1987 23 p Transl. into ENGLISH from Vysokomolekulyarnyye Soyedineniya, Seriya B (USSR), v. 9, no. 6, Jun. 1987 p 412; 443-447
(AD-A184668; FTD-ID(RS)T-0768-87) Avail: NTIS HC A03/MF A01 CSCL 11I

Selected articles from a translated journal are presented. Some titles of these articles are: Methacrylic Polymers with a Syndiotactic Structure on a Base of Esters of Phosphorus-Containing Alcohols; Permanent Dipole Moment in Associations of Polymethacrylic Acid and Polyvinyl Alcohol; Investigation of the Kinetics of Polymerization of Compounds When; and Acid Chloride of Carboxylic Acid-Tertiary Amine System. GRA

N88-11843# Princeton Univ., N.J. Dept. of Chemical Engineering.
CURE AND PROPERTIES OF THERMOSETTING POLYMERS Final Report, 1 Mar. 1984 - 31 Aug. 1987
John K. Gillham Aug. 1987 8 p
(Contract DAAG29-84-K-0037)
(AD-A184669; ARO-21259.8-MS) Avail: NTIS HC A02/MF A01 CSCL 11I

Thermosetting materials (e.g., epoxies and polyimides) are used in composites, coatings and adhesives. Unlike their thermoplastic counterparts, molecular structure macroscopic property relationships in thermosets are not well developed: hence the current research. A general model for thermosetting materials which relates polymerization to properties is being developed. In this, a time temperature transformation (TTT) cure diagram relates the principal states of matter encountered (i.e., liquid, rubber (sol/gel and gel), and glass (sol, sol/gel and gel) to gelation and vitrification phenomena. The model is extended to rubber-modified thermosetting systems to show that a given chemical formulation can provide different morphologies and hence different material behavior. It is also extended to high temperature polymers where polymerization and degradation reactions compete. Computed and experimental TTT diagrams are compared. GRA

N88-11844# National Bureau of Standards, Gaithersburg, Md. Ceramics Div.
INDENTATION DAMAGE IN CERAMICS Final Report, Mar. 1985 - Mar. 1987
Brian R. Lawn and B. J. Hockey 30 May 1987 52 p
(Contract MIPR-ARO-124-86)
(AD-A184686; ARO-215221.3-MS) Avail: NTIS HC A04/MF A01 CSCL 11B

The basic processes of indentation damage in brittle ceramics have been studied. Attention has focused on the roles of material crystallography and microstructure in determining the nature of the damage pattern. Microscopy techniques, particularly transmission electron microscopy, have been used to characterize the attendant deformation and fracture of Vickers indentation sites. Strength, toughness, and wear measurements have been carried out on polycrystalline materials to ascertain how the damage characteristics influence the ensuing mechanical properties. It is concluded that material microstructure can be a crucial factor in structural design with ceramics. GRA

N88-11845# Army Lab. Command, Watertown, Mass. Material Technology Lab.
ALUMINUM OXYNITRIDE SPINEL (ALON): A REVIEW Final Report
Normand D. Corbin Jul. 1987 21 p
(AD-A184753; MTL-MS-87-3) Avail: NTIS HC A03/MF A01 CSCL 11B

Aluminum oxynitride spinel (ALON) is a relatively new ceramic that can be processed into fully dense transparent material. There are a variety of applications where this material could replace alumina, especially where optical transparency and strength are important. This report reviews the current status of this material, including phase equilibria, processing, and properties. GRA

N88-11846# Oklahoma State Univ., Stillwater. Dept. of Physics.
DEFECT CHARACTERIZATION IN QUARTZ AND RELATED MATERIALS Final Report, Apr. - Dec. 1983
Larry E. Halliburton, Joel J. Martin, William A. Sibley, and Richard C. Powell Jun. 1987 150 p
(Contract F19628-83-K-0007)
(AD-A184754; RADC-TR-87-66) Avail: NTIS HC A07/MF A01 CSCL 20C

The substitutional aluminum ions present in all quartz require charge compensation. In as-grown synthetic quartz, interstitial alkalis serve as the charge compensators. Irradiation at temperatures above 200 K replaces the alkali with either a proton or a hole trapped on an adjacent oxygen. Electrodiffusion (sweeping) can be used to replace the alkali with either a proton or another specific alkali. A study of the acoustic loss of a series of 5-MHz fifth overtone AT-cut resonator blanks as a function of sweeping and irradiation has been completed. No acoustic loss peaks were observed at temperatures less than 100 C which could be attributed to either the Al Li or AL-OH centers. Na-swept samples showed the expected large loss peak at 53 K while unswept samples had only very small 53 K peaks. This result shows that in as-grown quartz, lithium is the primary charge compensating ion. Irradiation removed the 53 K peak and introduced new peaks at 23, 100 and 135 K. During anneal, these peaks were found to track with the AL-hole center. GRA

N88-11847# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
JOINING OF SILICON CARBIDE REINFORCED CERAMICS
D. N. Coon and R. M. Neilson, Jr. May 1987 36 p Presented at the Fossil Energy Materials Program Conference, Oak Ridge, Tenn., 19 May 1987
(Contract DE-AC07-76ID-01570)
(DE87-014881; EGG-M-15687; CONF-8705103-12) Avail: NTIS HC A03/MF A01

This research program will identify and develop techniques for joining silicon carbide fiber-reinforced ceramic composites of tubular geometries, primarily through the use of glass joining materials. The general tasks include: identifying, preparing, and characterizing glass compositions suitable for joining ceramic/ceramic composites; developing a joining methodology and evaluating the effects of process parameters on joint characteristics; fabricating and characterizing joints; and determining physical/mechanical properties and failure behavior of joints under ambient conditions, elevated temperatures, and simulated service environments. The majority of the effort during the last year has been directed towards characterization of glass compositions for use as joining materials. The following requirements for the glass brazing material were identified: the glass joining material should melt and flow at temperatures below those reported to degrade the properties of the composite material (approximately 1200 C); the glass joining material should not exhibit excessive chemical reactivity with SiC; ideally, the devitrified glass joint should exhibit good mechanical properties to 1000 C; and the glass composition should devitrify to crystalline phases which exhibit low thermal expansion and good chemical resistivity to promote thermal and chemical stability of the resulting joint. This review discusses the results of characterization studies of candidate joining glasses with respect to the above criteria. Also discussed are the results of some initial joining experiments. DOE

N88-11848# Lawrence Livermore National Lab., Calif.
TEMPERATURE HYSTERESIS AND MAGNETIC TRANSITIONS IN AMORPHOUS Fe-Ni-Zr ALLOYS
C. E. Violet, R. J. Borg, L. May, K. V. Rao, J. Nogues, R. D. Taylor, and A. P. Batra Sep. 1987 11 p Presented at the 32nd Conference on Magnetism and Magnetic Materials, Chicago, Ill., 9 Nov. 1987 Prepared in cooperation with Royal Inst. of Tech., Stockholm, Sweden, Los Alamos National Lab., N. Mex. and Howard Univ., Washington, D.C.
(Contracts W-7405-eng-48; W-7405-eng-36)
(DE88-000228; UCRL-96764; CONF-871126-2) Avail: NTIS HC A03/MF A01

Amorphous Fe89.3Ni0.3Zr10 and Fe70Ni20Zr10 alloys in the as-cast and irradiated states have been studied with Fe-57 Moessbauer spectroscopy, as well as ac and dc susceptibility. Samples were irradiated with 14-MeV neutrons at room temperature to fluences in excess of 10 to the 17th n/sq cm (nearly = to .0003 dpa). The effects of the neutron irradiation on the magnetic properties of the Fe89.7Ni0.3Zr10 alloy are minimal. Three new types of magnetic transitions have been discovered in the Ni(20) alloys. The first occurs in the as-cast sample. This is termed a slow spin-reorientation transition and occurs over the temperature range nearly = to 300 to 120 K. The neutron irradiation eradicated this transition but created two new transitions that occur only with the first cooldown: (1) a fast spin-reorientation transition occurring at a temperature or temperature range in the interval 300 to 280 K, and (2) a fast spin-randomizing transition with a starting temperature in the 240 to 200 K interval. Temperature hysteresis occurs only in the Ni(20) irradiated alloy. DOE

N88-11849# Midwest Research Inst., Golden, Colo.
POLYMERS IN SOLAR TECHNOLOGIES
H. H. Neidlinger and P. Schissel Sep. 1987 20 p Presented at the International Symposium on Polymers for Advanced

Technologies, Jerusalem, Israel, 16 Aug. 1987
(Contract DE-AC02-83CH-10093)
(DE88-001102; SERI/TP-255-3205; CONF-8708139-2) Avail: NTIS HC A03/MF A01

This paper describes some uses of polymeric materials in solar energy collection, identifies limiting problem areas, points out several potential areas of research, and closes with projected areas of future solar application. A key to the successful implementation of the various methods proposed for converting solar energy is the progress made by polymer scientists in developing polymers with the desired properties as well as with resistance to degradation. Polymeric materials offer potentially lower costs, lighter weight, easier processing, and greater design flexibility than materials in current use. However, cost effective design, fabrication, and operation of systems utilizing polymers must be based on a sound understanding of the properties and predicted performance of these materials in service, particularly the optical, thermomechanical, and diffusion barrier behavior and the effects of environmental aging. DOE

N88-11850# Pennsylvania State Univ., University Park. Polymer Science Section.
WITTIG SYNTHESIS OF CONDUCTIVE SEGMENTED BLOCK POLYMER COMPOSITIONS
Paul J. Hans and Bernard Gordon, III 1 Aug. 1987 5 p
(Contract N00014-85-K-0899)
(AD-A184018; TR-3) Avail: NTIS HC A02/MF A01 CSCL 07C

Conducting polymers such as polyacetylene and polyparaphenylene have been shown to have electrical conductivities which vary from the insulator to semiconductor and metallic regimes upon doping with electron acceptor or donor molecules. Unfortunately, many of these materials are plagued by undesirable properties such as oxidative instability (in the case of polyacetylene) and intractability or infusibility. Researchers have attempted improvements of the physical properties and environmental stability of polyacetylene by blending with elastomers, preparing composites with polyethylene film, and synthesizing block and graft copolymers. Some enhancements of the physical properties of the materials (eg. mechanical behavior, solubility behavior) compared to polyacetylene were generally observed. Electrical conductivities were generally less than for pure polyacetylene although stretching blend films was observed to enhance the conductivity, often by an order of magnitude over the unstretched film. In this paper we reported on the preparation of segmented block polymers prepared via a Wittig condensation of conductive poly(p-phenylene pentadienylene) oligomers and linear alkanes. It is felt that preparation of segmented block polymers will result in conductive materials with good mechanical properties providing phase morphology and size can be controlled. GRA

N88-11851# Pennsylvania Univ., Philadelphia. Dept. of Physics.
BOND CHARACTER AT A SILICON/COPPER SURFACE
C. H. Patterson, E. W. Plummer, and Richard P. Messmer Dec. 1986 2 p
(Contract N00014-86-K-0304)
(AD-A184167; TR-2) Avail: NTIS HC A02/MF A01 CSCL 07B

The ionic and covalent character of bonding is considered for the Si (111)-(5x5) Cu phase formed when one monolayer of copper is deposited on Si(111)(7x7) and subsequently annealed to 600 C. Localized orbitals and ab initio calculations have been employed to evaluate total energies and types of bonding for Cu adsorbed in several different sites, including the structure proposed by Chambers et al on the basis of their angle resolved Auger electron spectroscopy results. The relation between the bond character of this phase and its surface spectroscopic properties is discussed. GRA

N88-11852# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
BONDING AND COUPLING OF C SUB 1 FRAGMENTS ON METAL SURFACES
Chong Zheng, Yitzhak Apeloig, and Roald Hoffman Jul. 1987 17 p
(Contract N00014-82-K-0576)
(AD-A184186; TR-36) Avail: NTIS HC A03/MF A01 CSCL 07B

The bonding and reactivity of CH3, CH2, and CH fragments to Ti(0001), Cr(110) and Co(0001) metal surfaces is examined with extended Huckel, band calculations on two dimensional slabs of metal and adsorbate. A local chemical viewpoint is sought through fragment analyses, decompositions of the density of states and overlap population studies. All fragments tend to restore their missing C-H bonds when bound to these surfaces - CH3 prefers the on-top, CH2 the bridging and CH the capping geometry. CH3 anchors more strongly to the on-top site of a metal surface of high d band. GRA

N88-11853# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EFFECTS OF CURE PRESSURE ON RESIN FLOW, VOIDS, AND MECHANICAL PROPERTIES Interim Report, May 1986 - Apr. 1987
George S. Springer, Jian-Mao Tang, and Woo I. Lee Jul. 1987 84 p
(Contract F33615-84-C-5049)
(AD-A184267; AFWAL-TR-87-4058) Avail: NTIS HC A05/MF A01 CSCL 11D

The effects of cure pressure on resin flow, compaction, void content, and mechanical properties of fiber reinforced composites were investigated. Tests were performed on laminates made of Fiberite T300/976 and T300/934 unidirectional prepreg tape. Data are presented on compaction, resin flow, and void content which tend to support the validity of the Springer-Loos model. Data are also given showing the effects of cure pressure on void content and on the compressive strength and short-beam shear strength and modulus. GRA

N88-11854# Ballistic Research Labs., Aberdeen Proving Ground, Md.
DEVIATORIC CONSTITUTIVE RELATIONSHIP FOR ANISOTROPIC MATERIALS
Steven Segletes Jun. 1987 52 p
(AD-A184332; BRL-TR-2825) Avail: NTIS HC A04/MF A01 CSCL 20B

An anisotropic constitutive formulation is presented in which the deviatoric terms have been completely separated from the hydrostatic terms. In this way, a non-linear equation of state is readily employed. For code calculations employing an incremental strain approach, separating the hydrostatic terms from the deviatoric terms provides for a more accurate means of calculating pressure. This results because of the fact that the proposed deviatoric formulation allows evaluation of hydrostatic stress directly from dilatation. Such a scheme is less prone to cumulative integration error than existing formulations, which use stress increments as the basis for modifying hydrostatic pressure. The error is most severe when calculating pressure for materials with variable compressibility. Additionally, an error in the original formulation produces error in the pressure calculation when the material undergoes plastic flow. This flaw is eliminated in the present formulation. GRA

N88-11855# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
SYNTHESIS AND CHARACTERIZATION OF BLOCK COPOLYMERS
James C. Chien and Jun-Long Hong 1 Jul. 1987 5 p
(Contract N00014-85-K-0880)
(AD-A184405; TR-21) Avail: NTIS HC A02/MF A01 CSCL 07C

Segmented (AB)n Polyurethanes; A series of polyether-polyurethane (PEPU) segmented block copolymers were synthesized and characterized. Soft segments were poly(propylene oxide) (PPO; Mn = 2,000) or poly(tetrahydrofuran) (PTHF: Mn = 1,650). Hard segments were formed from 4,4'-diphenylmethane diisocyanate (MDI) and different short chain diols as chain extenders. In the PPO series, 1-5-pentandiol (P), diethylene glycol (D), triethylene glycol (T) and 1,3-bis(N,N'-methyl-N,N'-2-hydroxyethyl) isophthalimide (Bi(M)) were used as chain extenders. In the PTHF series 1,6-bis(N,N'-2-hydroxy-ethyl)adipamide (A), Bi(M), D, T, bis(N,N'-2-hydroxy-ethyl) isophthalamide (Bi(M)) and 1,6-bis(N,N'methyl-N,N'-2-hydroxy-ethyl) adapamide (A(M)) were used as chain extenders. By varying hard segment content, PEPU polymers with different properties were synthesized. GRA

N88-11856# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
SYNTHESIS AND CHARACTERIZATION OF BLOCK COPOLYMERS
James C. Chien and C. F. Chu 1 Jul. 1987 4 p
(Contract N00014-85-K-0880)
(AD-A184406; TR-22) Avail: NTIS HC A02/MF A01 CSCL 07C

Polyether-Polyimide Block Copolymers; Three series of Polyether-Polyimide (PEPI) block copolymers were synthesized. Soft segments were poly(propylene glycol) (PPO) Mn = 2,000 and 4,000. Hard segments were pyromellitic dianhydride (PMDA) and di-(2-hydroxyethyl)-dimethylhydantoin (H). The hard segments were formed from 4,4'-diphenylmethane disocyanate (MDI) with PMDA or 95% PMDA and 5% H. The first series designated as PEPI-2K was synthesized with PPO-2,000, MDI and PMDA. The second series, PEPI-2KH, used PPO-2,000, MDI, 95% PMDA + 5% H. The third series, PEPI-4K, used PPO-4,000, MDI and PMDA. PEPI copolymers in each series were varied by weight percent of hard segment. GRA

N88-11793# Joint Publications Research Service, Arlington, Va.
CORROSION RESISTANCE OF SILVER-PLATED CARBON-ALUMINUM COMPOSITE Abstract Only
E. Z. Napukh, I. M. Zhitkikh, A. I. Stepanov, A. T Manuylov, M. I. Morozova, S. I. Vorobeva, B. F. Trefilov, and N. P. Ignatova *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 10 Transl. into ENGLISH from Poroshkovaya Metallurgiya (Kiev, USSR), no. 8, Aug. 1986 p 45-47 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

N88-12013# Miyazaki Univ. (Japan). Dept. of Applied Physics.
ESTIMATIONS OF GRAVITATIONAL EFFECTS ON THERMAL DENATURATION PROCESS IN A BIOPOLYMER
Kanji Etori *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 97-105 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-11857# San Diego State Univ., Calif.
EVALUATION OF ONE-SIDED NUCLEAR MAGNETIC RESONANCE FOR REMOTE DETECTION OF EXPLOSIVES Final Report
L. J. Burnett and M. A. Fineman Jul. 1987 113 p
(Contract N66001-83-D-0203)
(AD-A184490; NOSC-TD-1118) Avail: NTIS HC A06/MF A01 CSCL 19A

This program was initiated to investigate the potential of nuclear magnetic resonance (NMR) for remote detection. Remote regions accessible from only one side and the remote detection of explosives were topics of particular interest. The program involved the following seven specific tasks and subtasks: (1) to identify the compounds of interest, both benign and explosive; (2) to locate and catalog available data on the compounds of interest; (3) to review current remote NMR technology; (4) to identify alternative remote NMR systems; (5) to define a figure-of-merit suitable for comparing the alternative NMR systems; (6) to use the figure-of-merit to identify the most promising of the alternative systems; and (7) to predict the performance of the chosen system. Each of these tasks was completed successfully. GRA

N88-11858# National Bureau of Standards, Washington, D.C. Molecular Spectroscopy Div.
FREE RADICAL DETECTION AND REACTIONS IN THE DECOMPOSITION OF ENERGETIC MATERIALS Final Report, 12 Jun. 1984 - 30 Jun. 1987
Marilyn E. Jacox 30 Jul. 1987 17 p
(Contracts MIPR-ARO-157-84; MIPR-ARO-105-86)
(AD-A184677; ARO-21495.4-CH) Avail: NTIS HC A03/MF A01 CSCL 19A

Infrared and ultraviolet absorption spectra have been obtained for a number of reaction intermediates which are expected to play important roles in the decomposition and combustion of energetic materials. In order to prevent molecular diffusion and subsequent reactions, the species of interest was trapped in a large excess of solid argon at cryogenic temperatures. The vibrational spectrum previously reported for the nitromethyl free radical has been further analyzed to give additional information on the structure and chemical bonding properties of that species. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N88-11859*# Alabama Univ., Huntsville.
CONSORTIUM FOR MATERIALS DEVELOPMENT IN SPACE. TECHNICAL SECTION Annual Report, 15 Sep. 1986 - 14 Sep. 1987
Sep. 1987 103 p
(Grant NAGw-812)
(NASA-CR-181508; NAS 1.26:181508) Avail: NTIS HC A06/MF A01 CSCL 22A

Several topics related to materials development in space are discussed. Physical vapor transport crystal growth, the mass spectroscopic faciiity, surface coatings and catalyst production by electrodeposition, mass transfer by diffusion, electrooptical organic materials, and high temperature superconductors are among the topics covered. For individual titles, see N88-11860 through N88-11871.

N88-11860*# Alabama Univ., Huntsville.
PHYSICAL VAPOR TRANSPORT CRYSTAL GROWTH
Dave W. Yoel (Boeing Aerospace Co., Seattle, Wash.), Elmer Anderson, Maw-Kuen Wu, and H. Y. Cheng *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 5-17 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

The goals of this research are two-fold: to study effective means of growing ZnSe crystals of good optical quality and to determine the advantages of growing such crystals in microgravity. As of this date the optimal conditions for crystal growth have not been determined. However, successful growth runs were made in two furnances and the results are given. Author

N88-11861*# Alabama Univ., Huntsville.
MASS SPECTROSCOPIC FACILITY

Franz Rosenberger *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 18-19 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

A mass spectrometer system is described. The investigations to be conducted with the completed facility will be concerned with the high-temperature out-gassing behavior of quartz ampoules and the vapor composition in crystal growth experiments. These will give some insight on the prevailing transport mechanisms in these crystal growth experiments and supply a realistic basis for the numerical modeling of heat and mass transfer in these systems. Author

N88-11862*# Alabama Univ., Huntsville.
MATERIALS PREPARATION AND LONGEVITY IN HYPERTHERMAL ATOMIC OXYGEN
Lyle E. Bareiss, Gary P. Sjolander (Martin Marietta Aerospace, Denver, Colo.), and John C. Gregory *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 20-31 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

Flight hardware fabrication, the design and fabrication of an atom beam source, construction of a surface science laboratory, and progress in research on processes and mechanisms of interaction of hyperthermal atoms at solid surfaces are discussed. Author

N88-11863*# Alabama Univ., Huntsville.
SURFACE COATINGS AND CATALYST PRODUCTION BY ELECTRODEPOSITION
Chester B. May (McDonnell-Douglas Astronautics Co., Huntsville, Ala.), Clyde Riley, H. Dwain Coble, and Boon H. Loo *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 32-48 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

Electrodeposition and electrocodeposition in low gravity are discussed. The goal is to provide a better understanding of the role of convection and buoyancy in the mechanisms of formation of some electrodeposited surfaces, fluid flow in the vicinity of electrodepositing surfaces, the influence of a moving medium upon codeposition, the effect of gravity upon the dispersion (coagulation) of neutral particles that are desired for codeposition and preparation of improved surface coatings and metal catalysts. Author

N88-11864*# Alabama Univ., Huntsville.
MASS TRANSPORT BY DIFFUSION
James K. Baird *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 49-52 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

For the purpose of determining diffusion coefficients as required for electrodeposition studies and other applications, a diaphragm cell and an isothermal water bath were constructed. the calibration of the system is discussed. On the basis of three calibration runs on the diaphram cell, researchers concluded that the cell constant beta equals 0.12 cm -2 . Other calibration runs in progress should permit the cell constant to be determined with an accuracy of one percent. Author

N88-11865*# Alabama Univ., Huntsville.
HIGHLY NON-LINEAR OPTICAL (NLO) ORGANIC CRYSTALS
J. Milton Harris *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 53-56 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

This research project involves the synthesis and characterization of organic materials having powerful nonlinear optical (NLO) properties and the growth of highly ordered crystals and monomolecular films of these materials. Research in four areas is discussed: theoretical design of new materials, characterization of NLO materials, synthesis of new materials and development of coupling procedures for forming layered films, and improvement of the techniques for vapor phase and solution phase growth of high quality organic crystals. Knowledge gained from these experiments will form the basis for experiments in the growth of these crystals. Author

N88-11866*# Alabama Univ., Huntsville.
HIGHLY NON-LINEAR OPTICAL (NLO) ORGANIC CRYSTALS AND FILMS. ELECTROOPTICAL ORGANIC MATERIALS
Samuel P. McManus, Franz Rosenberger, and John Matthews *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 57-63 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

Devices employing nonlinear optics (NLO) hold great promise for important applications in integrated optics, optical information processing and telecommunications. Properly designed organics possess outstanding optical and electrooptical properties which will substantially advance many technologies including electrooptical switching, optical amplification for communications, and parallel processing for hybrid optical computers. A brief comparison of organic and inorganic materials is given. Author

N88-11867*# Alabama Univ., Huntsville.
THEORY OF ATOMIC ADDITIVITY IN MOLECULAR HYPERPOLIZABILITIES
James K. Baird *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 64-71 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

Hyperpolarizability is a function of frequency. This is called dispersion. Because of the Kramers-Kronig relations, researchers expect that a material that is dispersing light is also absorbing it. Where there is both dispersion and absorption, the molecular polarizabilities are complex functions of the frequency. This led researchers to consider atomic additivity in both the real and imaginary parts of the ordinary and hyperpolarizabilities. This effort is desirable not only from a theoretical point of view, but also because of the existence of a large body of complex refractive index data, which may be used to test the additivity principle with the complex valued ordinary dipole polarizability. Author

N88-11868*# Alabama Univ., Huntsville.
PHYSICAL PROPERTIES OF IMMISCIBLE POLYMERS
J. Milton Harris *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 72-77 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

The demixing of immiscible polymers in low gravity is discussed. Applications of knowledge gained in this research will provide a better understanding of the role of phase segregation in determining the properties of polymer blends made from immiscible polymers. Knowledge will also be gained regarding the purification of biological materials by partitioning between the two liquid phases formed by solution of the polymers polyethylene glycol and dextran in water. Testing of new apparatus for space flight, extension of affinity phase partitioning, refinement of polymer chemistry, and demixing of isopycnic polymer phases in a one gravity environment are discussed. Author

N88-11869*# Alabama Univ., Huntsville.
HIGH TEMPERATURE SUPERCONDUCTORS c76
Maw-Kuen Wu *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 78-82 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 20L

The two principle objectives are to develop materials that superconduct at higher temperatures and to better understand the mechanisms behind high temperature superconductivity. Experiments on the thermal reaction, structure, and physical properties of materials that exhibit superconductivity at high temperatures are discussed. Author

N88-11870*# Alabama Univ., Huntsville.
CAST IRON FREEZING MECHANISMS
N. P. Lillybeck (Deere and Co., Moline, Ill.) and James E. Smith, Jr. *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 83-93 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 22A

This task focused on liquid phase sintering and infiltration studies of refractory metals and metal composites. Particular emphases was placed on those powered metal compacts which produce liquid alloys in sintering. For this class of materials, heating to a two phase region causes the constituent components to react, forming an alloy liquid which must wet the solid phase. Densification is initially driven by the free energy effects which cause rapid rearrangement. Further densification occurs by evaporation and condensation, surface diffusion, bulk flow, and volume diffusion. Author

N88-11871*# Alabama Univ., Huntsville.
WAKE SHIELD **c34**
Tommy Bannister (Wyle Labs., Inc., Huntsville, Ala.) and Gerald R. Karr *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 94-96 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 20D

Progress on the modeling of the flow field around a wake shield using a recently obtained code based on the Monte Carlo method is discussed. The direct simulation Monte Carlo method is a method for solving the Boltzman Equation using an approximation to the collision integral term. The collision integrand is evaluated for randomly selected values of its arguments and the summation will approach the integral for large enough samples. The collision effects may be modeled for either hard sphere or various power law potentials. The convective side of the Boltzman equation is approximated over a time step using a simple trajectory calculation of molecules as they travel through the domain of interest. Author

N88-11872*# Universities Space Research Association, Huntsville, Ala.
MATERIALS PROCESSING IN SPACE PROGRAM SUPPORT Final Report, 19 Apr. 1985 - 17 Mar. 1987
Martin Glicksman (Rensselaer Polytechnic Inst., Troy, N.Y.) and James M. VanAlstine 1 Nov. 1987 23 p
(Contract NAS8-36045)
(NASA-CR-179217; NAS 1.26:179217) Avail: NTIS HC A03/MF A01 CSCL 22A

Activities in support of NASA's Materials Processing in Space (MPS) program are reported. The overall task of the MPS project support contract was to provide the organization and administration of colloquiums, science reviews, workshops, technical meetings, bibliographic services, and visiting scientist programs. The research objectives and accomplishments of the University Space Research Association visiting scientist team are also summarized. M.G.

N88-12014# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
NUMERICAL ANALYSIS OF MARANGONI CONVECTION IN BRIDGMAN METHOD
Hiroyuki Uchida, Keiichi Kuwahara, and Shintaro Enya *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 107-115 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

N88-12145# Satimage, Kiruna (Sweden).
SATIMAGE AND THE NORDIC SPOT MARKET
Lars Bjerkesjoe *In* CNES, SPOT 1: First In-Flight Results 1987 p 19-24 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12146# SPOT Image Corp., Washington, D.C.
SPOT IMAGE CORPORATION: EARLY RESULTS
David S. Julyan *In* CNES, SPOT 1: First In-Flight Results 1987 p 25-31 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-11873# Joint Publications Research Service, Arlington, Va.
CHINA REPORT: SCIENCE AND TECHNOLOGY
9 Apr. 1987 105 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-015) Avail: NTIS HC A06/MF A01

Topics addressed include: national developments; physical sciences; applied sciences; scientists and scientific organizations; and environmental quality. For individual titles, see N88-11874 through N88-11879.

N88-11874# Joint Publications Research Service, Arlington, Va.
INTEGRATED 3-PARAMETER DIAGRAM FOR DETERMINING THERMODYNAMIC PROPERTIES OF FLUIDS **c77**
Guochang Zhao, Xiaoxue Deng, and Mingshan Zhu *In its* China report: Science and Technology 9 Apr. 1987 p 29-33 Transl. into ENGLISH from Ziran Zazhi (Shanghai, Peoples Republic of China), v. 9, no. 10, Oct. 1986 p 796-797 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

The importance of thermodynamic properties of fluids has motivated recent studies in developing methods of calculating thermodynamic properties. Among the various methods, the use of computational diagrams is a commonly used engineering method. Conventional diagrams do not take into consideration the internal relationships among the various thermodynamic properties. The internal relationships of various thermodynamic properties are considered. The Lee-Kessler three-parameter equations were used to construct an integrated three-parameter diagram for determining the thermodynamic properties of fluids; the curves were generated using an ai-M/6 microcomputer with an attached Sr 6602 plotter. The diagram is considered sufficiently accurate for engineering calculations. B.G.

N88-11875# Joint Publications Research Service, Arlington, Va.
GENERALIZED COUPLED-MODE EQUATIONS, APPLICATIONS TO FIBER COUPLERS **c39**
Jingren Qian *In its* China report: Science and Technology 9 Apr. 1987 p 34-38 Transl. into ENGLISH from Zhongguo Kexue Jishu Daxue Xuebao (Hefei, Peoples Republic of China), v. 16, no. 4, Dec. 1986 p 427-431 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

Generalized coupled-mode equations for two or more coupled weakly-guiding fibers when not well separated, are presented. These equations were used to study fiber couplers. Compared with the results derived from previous coupled-mode equations, the results are in better agreement with those calculated rigorously by a numerical method. Author

N88-11876# Joint Publications Research Service, Arlington, Va.
STATUS OF TITANIUM ALLOYS R AND D DESCRIBED **c26**
Fanchang Ceng *In its* China report: Science and Technology 9 Apr. 1987 p 39-45 Transl. into ENGLISH from Guoji Hangkong (Beijing, Peoples Republic of China), no. 10, 5 Oct. 1986 p 8-11 (For primary document see N88-11873 03-31)
Avail: NTiS HC A06/MF A01

After a brief chronological description of titanium alloys in the aviation industry, highlights are given on the achievements in manufacturing of large forgings, in particular, high speed hammer forging, high temperature forging, and isothermal die forging. A prospect of titanium alloy development is outlined. Author

N88-11877# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF BORON ON POROSITY IN NICKEL-BASE SUPERALLOY CASTINGS c26
Yaoxiao Zhu, Shunnan Zhang, Leying Xu, Yingjie Tong, Xiuzhen Ning, Zezhou Liu, Cuiping Hou, and Jing Bi *In its* China report: Science and Technology 9 Apr. 1987 p 46-54 Transl. into ENGLISH from Jinshu Xuebao (Beijing, Peoples Republic of China), v. 21, no. 1, 18 Feb. 1985 p A1-A8 Original language document was announced in IAA as A85-46812 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

The influence of B content on solidification and porosity formation in cast N-base superalloys was examined. Because the solubility of B in gamma-solid solution is limited, the melt at the solidification front may be enriched in B. For superalloys containing relatively more B, the solidified grain may be surrounded by a liquid coating with a much lower melting point which is extremely enriched in B. The microstructure reveals interconnected continuous weblike filling channels which expand the temperature range in the molten state and reduce the residual amount of liquid unable to fill the pores. The liquid pools are small and isolated, and the microporosities are finely distributed. The liquid web did not form in superalloys of normal B content. When dendritic grains interconnect quickly along certain rapidly-growing directions, the isolated pools may merge into large ones, and more serious porosity results. IAA

N88-11878# Joint Publications Research Service, Arlington, Va.
EFFECTS OF INJECTION OF FREE ELECTRON LASERS ON AXIAL VELOCITY SPREAD OF BEAMS c36
Yuandian Wang *In its* China report: Science and Technology 9 Apr. 1987 p 55-62 Transl. into ENGLISH from Zhongguo Jiguang (Shanghi, Peoples Republic of China), v. 13, no. 11, 20 Nov. 1986 p 671-674, 682 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

An electron beam can be injected into the interaction zone of a free-electron laser adiabatically or nonadiabatically. Nonadiabatic injection is preferred. For free-electron lasers with axial magnetic fields, initial perpendicular velocities can induce axial velocity fluctuations. In order to reduce the fluctuation amplitude, a step-like axial magnetic field can be applied for cooling the perpendicular temperature of the beam, for which proper selection of system parameters is necessary. Author

N88-11879# Joint Publications Research Service, Arlington, Va.
XeCl EXCIMER LASER WITH MAGNETIC COMPRESSOR c36
Qihong Lou, Jianping Qi, Runwen Wang, Yunrong Wei, Aizhen Ding, Jingxing Dong, Zean Ding, and Guoqing Wu *In its* China report: Science and Technology 9 Apr. 1987 p 63-69 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 13, no. 11, 20 Nov. 1986 p 683-686 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

The characteristics of adopting an excimer laser with a magnetic compressor are studied. Using this kind of technique the current pulse rise time can be compressed from 200 ns to 50 ns. The current pulse amplification and compression phenomena were computed, the reason for reduction of back current amplitude explained, and the effects of bypass inductance on the compression results provided. Author

N88-11880# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
14 Jul. 1987 129 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-031) Avail: NTIS HC A07/MF A01

Several articles on science and technology in China are given. Electronic countermeasures, laser ionization of the ammonia molecule, height profile inversion of ionospheric movement from the observed parameters of HF radio echoes, whistlers, mechanical properties of various metals, and geomorphology are among the topics discussed. For individual titles, see N88-11881 through N88-11887.

N88-11881# Joint Publications Research Service, Arlington, Va.
RADAR ECCM'S NEW AREA: ANTI-STEALTH AND ANTI-ARM c32
Nengjing Li *In its* JPRS report: Science and Technology. China (date) 1-14 (SEE N88-11880 03-31) 14 Jul. 1987 Transl. into ENGLISH from Dianzi Xuebao (Beijing, Peoples Republic of China), v. 15, no. 2, Mar. 1987 p 98-104 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

While stealth and anti-radar missiles will become major threats to military radars, many countermeasures are also being developed. The commonly used countermeasures against these two threats are: the use of bistatic (or multistatic) systems and low carrier frequencies. Some techniques are also effective against electronic jamming, e.g., low probability intercept techniques (including super-low sidelobe antenna, frequency hopping, flexible and variable coded signals), bistatic (multistatic) systems, weak signal detection and high radar mobility. Clearly, these techniques should be the focal point for current radar research. Author

N88-11882# Joint Publications Research Service, Arlington, Va.
RELAXATION EFFECT OF STARK SPLIT LEVELS FOR TWO-LEVEL SYSTEM INTERACTING WITH SYMMETRICAL STRONG RESONANT BICHROMATIC FIELD Abstract Only c32
Fuzi Yang and Yizhuang Xu *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 15 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 3, Mar. 1987 p 193-199 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

Using the semi-classical theory, density matrix method and probe field approximation and taking into account the relaxation effect, researchers investigated the Stark split phenomenon for a two-level system interacting with a strong resonant bichromatic field. In the case in which two strong fields have the same amplitude and symmetrical detuning of frequency, the relaxation effect not only influences the weight of the split levels created from the optical Stark effect and broadens these levels, but also the new split levels can be found in a new position. It is predicted that these new satellite lines of spectra can be observed in the optical spectrum. Author

N88-11883# Joint Publications Research Service, Arlington, Va.
XeCl EXCIMER LASER INDUCED MULTIPROTON IONIZATION OF AMMONIA MOLECULE Abstract Only c36
Jingcheng Han and Rong Zhu *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 16-17 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 3, Mar. 1987 p 216-222 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

XeCl excimer laser induced multiphoton ionization and fragmentation of NH sub 3 are investigated using a molecule-beam apparatus and modified quadrupole mass spectrometer. Researchers observed two mass peaks due to NH sub 2 (+) and NH sub 3 (+) at m/e = 16 and 17, and also found a very strong mass peak of NH sub 4 (+) at m/e = 18. The yield dependences for various ions on the parent molecular pressure and laser power were measured in order to have a better understanding of the generation mechanism for various ions, particularly the NH sub 4 (+) ion. Author

N88-11884# Joint Publications Research Service, Arlington, Va.
HEIGHT PROFILE INVERSION OF IONOSPHERIC MOVEMENT FROM OBSERVED PARAMETERS OF HF RADIO ECHOES Abstract Only c32
Weixing Wan and Jun Li *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 19 Transl. into ENGLISH from Kongjian Kexue Xuebao (Beijing, Peoples Republic of China),

v. 7, no. 2, Apr. 1987 p 85-94 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

Under conditions of an unstable, inhomogeneous and anisotropic ionosphere, some relationships among the dynamic parameters of the ionosphere and observations of HF radio echoes reflected from the ionosphere are derived from general ray equations. Based on these relationships, a method is proposed to invert the height profile of the electron density, N(Z), and the height profile of the normal velocity, V(Z), of the constant electron density surface from the observed Dopplionogram, gonionogram, ionogram and rangionogram. In addition, comparing the possible combinations of the radio wave observations which are necessary and sufficient for the determination of height profiles of V(Z) and N(Z), the researchers suggest a new ionosonde operation mode to observe large-scale ionospheric disturbances, such as the gravity waves from a single station. This may be the theoretical basis for data analysis and instrumental improvement of the modern ionosonde. Author

N88-11885# Joint Publications Research Service, Arlington, Va.
METHOD ESTIMATING INTEGRAL MEAN VALUE OF ENHANCEMENT FACTOR AND PATH LATITUDE FOR WHISTLERS BELOW MAGNETIC LATITUDE 10 DEG Abstract Only **c46**
Youshan Wang *In its* JPRS report: Science and Technology: China 14 Jul. 1987 p 21 Transl. into ENGLISH from Kongjian Kexue Xuebao (Beijing, Peoples Repubic of China), v. 7, no. 2, Apr. 1987 p 146-153 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

The propagation of whistler-mode waves in the ionosphere is assumed to be ducted propagation. In other words, the waves will be presumed as traveling along magnetic field lines. An analytic solution of the whistler dispersion equation is obtained in terms of the electron density models of the ionosphere, the transverse gradient of the electron density required for guiding whistler mode waves along a magnetic field line, and an empirical formula for the magnetic field lines of the 1980's IGRF (n=8). Here, the electron density enhancement factor is defined as N sub c/N sub g-1. N sub c is the electron density at the center of the duct; N sub g is the background electron density at the latitude where the duct center lies. Thus, the integral mean value of the enhancement factor required and the path latitude can be analytically determined by a set of observed values: N sub m F2 and h sub m F2 of the ionosphere, and D (whistler dispersion). Author

N88-11886# Joint Publications Research Service, Arlington, Va.
THREE-DIMENSIONAL CALCULATION IN HIGH SUBSONIC AXIAL COMPRESSOR ROTOR AND ITS COMPARISON WITH L2F VELOCITY MEASUREMENT Abstract Only **c34**
Qinghuan Wang *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 32 Transl. into ENGLISH from Gongcheng Rewuli Xuebao (Beijing, Peoples Republic of China), v. 8, no. 2, May 1987 p 119-124 Original language document was announced in IAA as A87-51809 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

As a part of the basic research program to increase the understanding of the internal flow in high subsonic and transonic flow compressors and to improve the design and analysis calculation methods, a two-focus laser velocimeter has been employed in measuring the velocity and the flow angles in a compressor rotor running at peak efficiency points of several partial design speeds. Three-dimensional flow calculation has also been undertaken for these off-design conditions. The outlet velocity measured by the velocimeter, outlet stagnation pressure measured by pitot tubes, and isentropic rotor efficiency measured by a phase difference torquemeter are used as input values to the theoretical calculation. The variation of flow on the S (2m) surface and on the S1 surfaces, as measured by the velocimeter, agrees reasonably well with the calculated variation. This indicates that the three dimensional calculation method used can give a good picture of the internal flow in the compressor rotor. Author

N88-11887# Joint Publications Research Service, Arlington, Va.
FINITE ELEMENT ANALYSIS OF THREE-DIMENSIONAL STEADY AND UNSTEADY TEMPERATURE FIELDS (COMPUTATION OF TEMPERATURE DISTRIBUTION OF TURBINE BLADE WITH COMPOSITE COOLING) Abstract Only **c34**
Shouli Ji *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 33 Transl. into ENGLISH from Gongcheng Rewuli Xuebao (Beijing, Peoples Republic of China), v. 8, no. 2, May 1987 p 159-165 Original language document was announced in IAA as A87-51815 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

Three dimensional temperature distributions of steady and unsteady states for a turbine blade have been calculated using the finite element method. The boundary conditions consist of convective heat transfer of gas heating, internal cooling, film cooling, and impinging cooling. The results show that the temperature distribution of the computed blade is satisfactory, and the computer program is suitable for practical use. Author

N88-11888# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
10 Jun. 1987 106 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-025) Avail: NTIS HC A06/MF A01

Topics addressed include: laser applications; lasers; metamorphism; physical sciences; computers; marketing; and mineralogy. For individual titles , see N88-11889 through N88-11896.

N88-11889# Joint Publications Research Service, Arlington, Va.
TWO-LASER RESONANCE ENHANCED PHOTOIONIZATION SPECTRUM OF GAS PHASE BENZENE Abstract Only **c36**
Junying Fan, G. Muller, W. E. Schmid, K. L. Kompa, and J. L. Lyman *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 1-2 Transl. into ENGLISH of Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 1, Jan. 1987 p 1-10 Prepared in cooperation with Max-Planck Inst. for Quantum Optics, Munich, Federal Republic of Germany (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

The results of a two-laser resonance enhanced photoionization experiment with benzene molecules are reported. The excitation was provided by two frequency doubled dye lasers. The first laser pumped the molecule to a selected single data (S-1), from where it was ionized by a time delayed pulse of the second laser. The ion quantum yield depends on the intermediate vibronic state as well as on the wavelength of the ionizing laser. From the structure and intensity of the measured ion spectrum, vibrational frequencies and molecular parameters of the ground electronic state of the ion that were highly precise were derived. The contributions of autoionizing Rydberg levels to the ionization cross sections could be clearly distinguished from those of the direct ionization. Some of these resonance peaks could be assigned to vibrations within these Rydberg states. Author

N88-11890# Joint Publications Research Service, Arlington, Va.
INTRACAVITY ABSORPTION SPECTROSCOPY WITH RING TRAVELING-WAVE DYE LASER Abstract Only **c36**
Huayong Yong *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 5 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 1, Jan. 1987 p 11-16 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

By using a CW ring traveling-wave dye laser enhancement factor up to 10,000 of the intracavity absorption, sensitivity was obtained in air even if the pump power was two times over the threshold. Using the single-frequency scanning method for the first time, a resolution of .01 angstrom was measured without

sensitivity reduction. The experimental results agree with the predictions of the modified Brunner-Paul theory. Author

N88-11891# Joint Publications Research Service, Arlington, Va.
STUDY OF IR LASER PHOTOACOUSTIC SPECTRA OF ORGANIC MOLECULES ADSORBED ON METAL SURFACE **c36**

Huizong Lu, Kaitai Chen, and Zhaoyong Wang *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 7-13 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6, no. 12, Dec. 1986 p 1057-1062 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

Using a branch-tuning CW CO2 laser in the range of 0.2 to 10.8 microns, the IR photoacoustic spectra of organic molecules absorbed on a silver surface were studied. The absorbed molecular spectra of four layers of arachidic acid and cellulose diacetate with different surface densities was studied. No peak shift was found in a comparison between IR photoacoustic spectra of solid arachidic acid near 944/cm and the corresponding IR Fourier spectra of solid archidic acid. The IR photoacoustic spectra of cellulose diacetate with sigma sub 1 = 14,000/sq cm and sigma sub 1 = 5.5 x 10 to the 15th/sq cm respectively was compared with the corresponding transmission spectra of solid cellulose diacetate. It was found that the peak of the former near 1054/cm had a red shift of about 5/cm while the peak of the latter had no obvious shift within the range of accuracy of the experiment. Author

N88-11892# Joint Publications Research Service, Arlington, Va.
GENERATION OF IR STIMULATED RADIATION, UV VISIBLE VIOLET COHERENT RADIATION BY TWO-PHOTON RESONANCE PUMPING IN K VAPOR **c72**

Zugeng Wang, Xiaoling Tang, Kiachang Zhang, and Yishan Zheng *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 14-24 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6 no. 12, Dec. 1986 p 1063-1070 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

When two-photon excited potassium atoms reach the 7S energy level, a series of photo-pumped stimulated emissions and cascade stimulated emissions are observed in the infrared region. The processes of photo-pumped stimulated emission and two-photon resonance four-wave mixing of pumped light produced corresponding strong coherent emission at 6P-4S and 5P-4S. These two coherent emissions also had the function of pumped light and through a succession of four wave mixing processes produced several coherent emissions in the ultraviolet and the visible regions. The process of generation of these observed infrared stimulated emissions as well as the ultraviolet and visible coherent emissions are discussed. Author

N88-11893# Joint Publications Research Service, Arlington, Va.
ULTRA-SHORT PULSE LASER SYSTEM USED FOR LAGEOS RANGE FINDING **c36**

Huijuan He, Yongchun Li, Shengru Gu, Linxing Qian, Longxing Zhao, Detong Tan, Chikun Xiao, Wanzhen Cheng, and Fumin Yang *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 25-31 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6 no. 12, Dec. 1986 p 1092-1097 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

A Nd:YAG ultra short pulse laser system is described. The system's single pulse output energy at 1.06 micron wavelength is greater than 100 mJ. Through a frequency doubler, pulse outputs of 50 mJ at 0.53 micron were obtained. The system was used on a range finder with main mirror of theta 600 mm at the Shanghai Observatory and measured the laser geodynamic satellite (LAGEOS). The ranging distance was 8000 km with an accuracy of 5 cm. Author

N88-11894# Joint Publications Research Service, Arlington, Va.
LARGE-APERTURE HIGH-EFFICIENCY FREQUENCY DOUBLING USING TANDEM KDP CRYSTALS **c76**

Xijie Cai, Meilan Dai, Jiajun Lang, Ruixi Lu, and Wenhua Qin *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 32-41 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6, no. 12, Dec. 1986 p 1098-1104 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

The theory of tandem frequency doubling and relative orientation requirements of two crystals are presented. Using two 1.4 cm thick type 2 KDP crystals and incident base frequency laser intensity of 0.33 to 0.67 GW/sq cm, the external efficiency was over 60 percent and the laser beam diameter 42 mm. The theoretical results matched quite well with experimental values. Comparisons of the experimental features of a tandem frequency doubling with L sub 1 = L sub 2 = 1.4 cm to those of single crystal frequency doublers with thicknesses of 3 and 1.4 cm. The results showed that the tandem frequency doubler had the advantages of both the thin and thick crystal frequency doubler. Author

N88-11895# Joint Publications Research Service, Arlington, Va.
GENERALIZED HYBRID VARIATIONAL PRINCIPLE, CORRESPONDING FINITE ELEMENT MODEL **c39**

Wanji Chen *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 42-50 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 7, no. 5, May 1986 p 443-449 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

Based on the more generalized variational principle proposed by Professor Qian Weichang, an even more generalized hybrid variational principle suited for use in finite element methods is provided. From this, a general hybrid model is established. Further, with varying thickness thin plate bending elements as an example, a comparison was made of various hybrid elements as established based on different general variational principles. Author

N88-11896# Joint Publications Research Service, Arlington, Va.
COMPACTNESS OF QUASI-CONFORMING ELEMENT SPACES, CONVERGENCE OF QUASI-CONFORMING ELEMENT METHOD **c64**

Hongqing Zhang and Ming Wang *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 51-71 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 7, no. 5, May 1986 p 409-423 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

The compactness of quasi-conformal element space is discussed, generalizing the Rellich compactness theorem to quasi-conformal element space sequences with certain properties then it extends the generalized Poincare, Friedrichs, and Poincare-Friedrichs inequality formulae to quasi-conformal element space. Then the convergence and error approximation of the quasi-conformal element method is discussed. It is proved that if a quasi-conformal element space is approximate and strongly continuous, satisfies the element order condition and passes the IPT test, then the approximate solution is convergent. As examples, it is shown that convergence precision of 6, 9, 12, 15, 18, and 21 parameter quasi-conformal elements under the L sup 2, sup 2 (omega) norm respectively are O(h sub tau), O(H sub tau), O(h sup 2 sub tau), O(h sup 2 sub tau), O(h sup 3 sub tau), and O(h sup 4 sub tau) order of magnitude. Author

N88-11897# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA

28 Aug. 1987 123 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-034) Avail: NTIS HC A06/MF A01

Several topics related to science and technology in China are discussed. An analysis of compressible flow effects on high-velocity jet penetration, a transverse flow excimer laser, the physical design of a Nd:YAG disc laser and the status of laser development in

China are among the topics discussed. For individual titles, see N88-11898 through N88-11907.

N88-11898# Joint Publications Research Service, Arlington, Va.
ANALYSIS OF COMPRESSIBLE FLOW ON HIGH-VELOCITY JET PENETRATION **c02**
Xiao Lin and Jihai Wang *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 1-11 Transl. into ENGLISH from Binggong Xuebao (Beijing, People's Republic of China), no. 3, Aug. 1986 p 20-27 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

An analytical procedure for studying the interaction of a compressible jet with a target using p-D curves is presented. This method greatly facilitates the analysis of subsonic and supersonic flows and gives a clear picture of the problem. By matching the Hugoniot parameters with the Murnaghan state equation, not only the entropy variation caused by the shock wave is taken into account, but the solution is simplified. In particular, the derivation of an analytical expression between the wall pressure P sub w and free stream Mach number Ma provides a convenient formula in actual application. The calculated results are shown to be in good agreement with those calculated using other state equations. Author

N88-11899# Joint Publications Research Service, Arlington, Va.
COMBINED CALCULATION OF DEFORMATION AND STRESS FOR THE BODY AND SABOT OF AN APFSDS **c39**
Mingang Qian *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 12-20 Transl. into ENGLISH from Binggong Xuebao (Beijing, People's Republic of China), no. 3, Aug. 1986 p 28-34 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

The calculation of stress and deformation of the body and sabot of a high velocity armor piercing fin-stabilized discarding sabot (APFSDS) at the instant of launch is an important part of the strength design process. Here, the substructural capability of a program is used to carry out a combined calculation of stress and deformation for the body and sabot of an APFSDS. By treating the radial and axial degrees of freedom of the coupled nodes on the contact surface of the body and sabot separately, improved results are obtained. Author

N88-11900# Joint Publications Research Service, Arlington, Va.
NEW PHYSICAL EXPLANATION OF PHASE-CONJUGATE WAVES PRODUCED IN BACKWARD SIMULATED SCATTERING **c32**
Guangsheng He, Dun Liu, and Songhao Liu *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 21-28 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 13, no. 10, 20 Oct. 1986 p 618-622 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

A new physical explanation is given of the process whereby backward simulation scattering (BSS) produces phase-conjugate (PC) waves. It is believed that what is happening in this process is that there are two nonlinear processes simultaneously present: a pure stimulated scattering process and a partial degeneration four-wave mixing-frequency phase-complex conjugate process. The tight coupling of these two processes makes the BSS wave possess, to a certain degree, the features of a phase conjugate to the incident wave. Experimentally, a detection method for four-wave mixing frequency was adopted and confirmed the theoretical results. Author

N88-11901# Joint Publications Research Service, Arlington, Va.
A 10 W TRANSVERSE FLOW EXCIMER LASER **c36**
Qihong Lou, Chengen Zheng, Miao Jiang, Yueqing Jiang, Zean Ding, Aizhen Ding, Jingxing Dong, Yunrong Wei, Jianping Qi, and Runwen Wang *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 29-36 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 13, no. 10, 20 Oct. 1986 p 635-638; 645 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

An ultraviolet (308 nm) excimer laser with output power of 10 W is discussed. Features of the gas circulating system and the X-ray pre-ionization dosage distribution are given. The effect of gas flow velocity on the laser output is also discussed. Author

N88-11902# Joint Publications Research Service, Arlington, Va.
SATURABLE ABSORBERS FOR COLLIDING PULSE-LOCKED Nd:YAG LASERS **c36**
Xing Lin, Wenzhen Zhang, Fengtie Wu, Huiming Zhuang, Yunshan Zheng, and Zhanao Sun *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 37-40 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 13, no. 10, 20 Oct. 1986 p 664-665 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

The mode-locking of pentamethylidyne dissolved in various solvents was studied and the average pulse duration measured. The mode-locked pulse trains using pentamethylidyne, and BDN as the saturable absorbers were observed on a 500 MHz oscilloscope respectively, and their mode-locking quality and stability were compared. Author

N88-11903# Joint Publications Research Service, Arlington, Va.
EXCIMER LASER CELL WITH LONGITUDINAL ELECTRON-BEAM EXCITATION **c36**
Zhenhua Guo, F. K. Tittle, and J. Liegel *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 41-49 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 245-249 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

An electron beam longitudinally pumped excimer laser is described. The magnetic field produced by a field coil and its effect on the electron beam is analyzed. A current viewing resistor (CVR) and probe coil with integrater are used to study the magnetic field while a Faraday probe and diazochrome films are used to detect the position and spatial full width half magnitude values. With a graphite disc-calorimeter, the total energy of the electron beam is measured giving the tunable XeF laser output. Author

N88-11904# Joint Publications Research Service, Arlington, Va.
PHYSICAL DESIGN OF PARAMETERS OF Nd:YAG DISK LASER **c36**
Meizhen Zhang, Weilou Cao, Qinghao Chen, and Fulin Tang *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 50-55 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 256-258 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

Using a large Nd:YAG crystal grown by the temperature gradient method, researchers built a 40 mm aperture disk laser. The key problems that had to be resolved to set up the disk laser were suppression of parasitic oscillation in the disk and removal of waste thermal energy in the disk. Author

N88-11905# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF BN CO2 WAVE GUIDE LASER **c36**
Fuquan Zhang, Zhonghua Zhang, Fengmei Liu, Yusan Wang, Taixun Zhu, and Jingshan Zhao *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 56-61 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 262-264 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

Two kinds of CO2 wave guide lasers constructed using boron nitride ceramic produced in China are discussed. One is a hollow cylinder CO2 wave guide laser (1.6 X 100 mm) with output power of 700 mW. The other is a square CO2 wave guide laser (1.5 X 1.5 X 150 cubic mm) with output power of 1.5 W. Boron nitride

ceramic has the advantages of good thermal conductivity and extremely low thermal expansion coefficient. Author

N88-11906# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL STUDY OF STABILIZING He-Ne LASER OUTPUT POWER WITH TRANSVERSE MAGNETIC FIELD c36
Shunchao Xu and Guojung Lei *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 62-65 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 274; 275-276 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

A new method for stabilizing the output of a He-Ne laser by applying a variable transverse magnetic field to a portion of the discharge tube of the laser is discussed. This method can make the stability of the laser output power better than 0.05 percent and yet the output power will not fall below the original level. Author

N88-11907# Joint Publications Research Service, Arlington, Va.
STATUS, DEVELOPMENT OF LASER DEVICES IN CHINA c36
Xinneng Wo *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 66-75 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 7, no. 2, Apr. 1987 p 49-53 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

The development in China of high power lasers, crystal lasers, semiconductor lasers, gas lasers, chemical lasers, free electron lasers, ultra-short pulse lasers, and tunable dye lasers is discussed. There is also some discussion of problems related to further development of lasers in China. Author

N88-11908# Illinois Univ., Urbana. Dept. of Materials Science and Engineering.
ION PLATING: FUNDAMENTAL PROCESSING STUDIES AND SYNTHESIS OF HIGH PERFORMANCE COATINGS Final Report, Nov. 1983 - Apr. 1987
J. M. Rigsbee 4 Aug. 1987 6 p
(Contract DAAG29-83-K-0151)
(AD-A184766; ARO-21067.6-MS) Avail: NTIS HC A02/MF A01 CSCL 11C

Ion plating is a physical vapor deposition process which uses a plasma to modify the microstructure/microchemistry of thin film coatings. This research has directly shown that processing variables such as plasma energy/density; substrate temperature; deposition rate; and substrate surface chemistry directly effect the deposited film microstructure and chemistry. This processing technique allows mechanically strong/chemically graded interface layers to be produced between dissimilar material. Film adhesion with this process is correspondingly excellent. This process was used to produce corrosion and wear resistant hard coatings. GRA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-11909# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
THEORETICAL ASPECTS OF TARGET CLASSIFICATION
Jun. 1987 221 p Lecture series held in Rome, Italy, 29-30 Jun., in Neubiberg, Fed. Republic of Germany, 2-3 Jul., and in Noresund, Norway, 6-7 Jul. 1987
(AGARD-LS-152; ISBN-92-835-1553-6) Copyright Avail: NTIS HC A10/MF A01

Various analytical methods and, their numerical implementation, for generating and classifying target signatures under transient and steady state illumination, with emphasis on classification schemes that facilitate extraction of unknown target features in the inverse problem of identification are discussed. Included also are numerical modeling, experimental results obtained under controlled and realistic conditions, and descriptions of range facilities. For individual titles, see N88-11910 through N88-11921.

N88-11910# Polytechnic Inst. of New York, Farmingdale. Dept. of Electrical Engineering and Computer Science.
TARGET STRENGTH: AN OVERVIEW OF SOME RECENT THEORETICAL DEVELOPMENTS
Leopold B. Felsen *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 15 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

A brief review is given of some recent developments and trends in the theory of target scattering and classification. Emphases is on phenomena at high and moderate frequencies. It is in these parametric regions where wave transport phenomena play an essential role. Author

N88-11911# Ohio State Univ., Columbus. ElectroScience Lab.
UNIFORM GEOMETRICAL THEORY OF DIFFRACTION
P. H. Pathak *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 20 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

Keller's geometrical theory of diffraction (GTD) represents a major breakthrough in solving a wide variety of electromagnetic (EM) radiation and scattering problems at high frequencies. In particular, the GTD is an extension of geometrical optics to include a class of diffracted rays via a generalization of Fermat's principle. These diffracted rays are initiated, for example, from geometrical and electrical discontinuities in a scatter, or from points of grazing incidence on smooth convex parts of the scattering surface. However, being a pure ray optical theory, the original GTD falls within the transition regions adjacent to geometric optical shadow boundaries where the diffracted field generally assumes its largest value. This limitation of the GTD is overcome via the uniform version of the GTD which requires the diffracted field to make the total high frequency field continuous across the optical shadow boundaries. The UTD solutions for the diffraction by edges and smooth convex surfaces are reviewed in detail after introducing the basic concepts of GTD. Author

N88-11912# Naval Postgraduate School, Monterey, Calif.
SINGULARITY EXPANSION METHOD: TARGET RESONANCES
Michael A. Morgan *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 5 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

A unified treatment for the natural mode representations for induced currents and scattered fields is described using elementary concepts of causality and superposition. The transient back-scattered field is shown to have the form of a constant coefficient exponential series only in the late-time, after the last directly driven response is received from the scatterer. Prior to this, the early-time response is found to be due to both the direct physical optics fields as well as to a sum of modulated natural modes. Practical implications of this result, regarding aspect-invariant target classification using natural resonances, are discussed. Author

N88-11913# Tel-Aviv Univ. (Israel). Dept. of Electrical Engineering.
THE HYBRID WAVEFRONT RESONANCE METHOD
Ehud Heyman *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 24 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

When observed over long periods, scattered returns from targets illuminated by broad band signals reveal distinctive features in the early and late time regimes. The features can be explained in terms of the different wave phenomena, progressive and oscillatory, that are dominant during these respective intervals. A recently developed hybrid theory has formulated the connection between them and has provided new interpretations that did not emerge in earlier treatments. These interpretations can clarify issues which have arisen within the singularity expansion method (SEM), in particular, the adequacy of the expansion at early times. Here, the hybrid wavefront resonance theory is reviewed, first within the vigorous context of scattering by a circular cylinder, and then via a ray analysis of scattering by a general (composite) object.
Author

N88-11914# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Hochfrequenztechnik.
PHYSICAL OPTICS METHOD: PREDICTION OF RADAR SIGNATURES
V. Stein *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 17 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

There has been increasing interest in the use of the physical optics method in the computation of radar signatures of complicated objects which are large compared to the wavelength. A series of ideal conducting structures for which the physical optics method has been successfully applied to compute the back-scattered field is presented. The basic idea of physical optics following the Huygens-Helmholtz principle is evaluated. The surface integrals for the electromagnetic scattered field are presented and discussed. Some details of the physical optics method, when applied to complicated structures, are considered in the form of a short survey. This includes the hidden surface problem, the ability to predict depolarization effects for certain situations, the evaluation of the phase integral, the extension of physical optics to treat double reflections, the accuracy of the geometrical model and an estimation of the computer time. In the conclusion, some steps for the further extension and improvement of the physical optics method are summarized.
Author

N88-11915# Kassel Univ. (West Germany). Dept. of Electrical Engineering.
THEORETICAL ASPECTS OF TARGET CLASSIFICATION: PHYSICAL OPTICS AND RADON TRANSFORM METHODS
K. J. Langenberg *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 15 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

Target classification is set up as a multidimensional inverse scattering problem for electromagnetic waves. The target is considered to be of compact support residing in a media with constant wave speed. The scattered field produced by a prescribed incident field is represented by its equivalent sources in terms of Huygens' principle: for the sake of simplicity, the inversion of this representation of the physical optics or weak scatterer approximation linearizes the inverse problem resulting immediately in an inversion formula for the characteristic or singular function of the scatterer if the scattered field is measured as a function of frequency - or as broadband transients - on a closed surface sufficiently remote from the target in an either bistatic or monostatic experimental arrangement.
Author

N88-11916# Arizona Univ., Tucson. Electromagnetics Lab.
PARAMETRIZATION IN SCATTERING MODELS
D. G. Dudley *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 17 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

Parametric modeling in transient wave scattering is discussed. Global modeling based on the body resonances of the scattering object are discussed along with two examples. The nature of the incompleteness of global models is discussed. The concept of the local model, based on ray optic methods, is introduced. Included is an example of local modeling. It is shown that the local model is an order of magnitude more parsimonious and more robust in the presence of noise, compared to the global model. It is concluded that the local model has a better probability of success in practical target classification because of its performance in a noisy environment.
Author

N88-11917# Naval Postgraduate School, Monterey, Calif.
INPUT SIGNAL SHAPING: K-PULSE
Michael A. Morgan *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 16 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

Classification of electromagnetic scatterers by selective mode annihilation is discussed. After providing a brief description of historical background, the conceptual basis of this methodology is developed, followed by a theoretical explaination of the techniques that are employed. Some particular resonance annihilation schemes that have been implemented and tested are illustrated. Results from the tests using synthetic signals, integral equation computations and experimental transient scattering measurements are featured.
Author

N88-11918# Naval Postgraduate School, Monterey, Calif.
NUMERICAL MODELING: FINITE METHODS
Michael A. Morgan *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 17 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

Recent developments in computational methods for unbounded electromagnetic problems involving antennas and scattering are considered. Emphasis is given to the numerical implementations of differential equation based formulations using either finite differences or finite elements. Elementary examples are used as conceptual vehicles for introducing finite element and unimoment techniques. The finite element boundary integral method and the field feedback formulation are discussed. Current capabilities are demonstrated by considering some of the important research results utilizing the finite methods.
Author

N88-11919# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Hochfrequenztechnik.
NUMERICAL MODELING: INTEGRAL EQUATION METHOD
V. Stein *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 20 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

A review is given of the different expressions for the representation of the electromagnetic fields by integrals over the surface current. The integral equations, which mostly are used for the solution of practical problems, are discussed and the method of moments is outlined, where the use of pulses as basis functions is emphasized. Estimations of the core storage and the computer time are given. Two geometrical models for the scattering structure are dissused in more detail: the service patch model and the wire-grid model. A list of application examples of the integral equation method with references is given. Two further examples are outlined in detail: computation of the radiation pattern of an antenna mounted on a helicopter and determination of the extreme near field of a cube.
Author

N88-11920# Naval Postgraduate School, Monterey, Calif.
EXPERIMENTS: TEST RANGE FACILITIES, PART 1
Michael A. Morgan *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 16 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

A brief review is given of some of the transient electromagnetic scattering ranges at U.S. universities and research facilities. The Transient Electromagnetic Scattering Laboratory located at the Naval Postgraduate School is discussed. Particular attention is given to the role of this facility in studies of natural resonance

target classification studies. Detailed consideration is given to measurement concepts of transient scattering, with examples given to illustrate the procedures and requisite signal processing that is involved. Author

N88-11921# Arizona Univ., Tucson. Electromagnetics Lab.
EXPERIMENTS: TEST RANGE FACILITIES, PART 2
D. G. Dudley *In* AGARD Theoretical Aspects of Target Classification Jun. 1987 10 p (For primary document see N88-11909 03-32)
Copyright Avail: NTIS HC A10/MF A01

A description is given of the electromagnetic transient range facility at the Lawrence Livermore Laboratory. The range design and the instrumentation for both time domain and broadband frequency domain measurements are discussed. Two examples of experiments are given: scattering from a conducting plate and transmission through an aperture in a screen. Author

N88-11922# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
NBS (NATIONAL BUREAU OF STANDARDS) CALIBRATION PROCEDURES FOR HORIZONTAL DIPOLE ANTENNAS (25 TO 1000 MHz)
D. G. Camell, E. B. Larsen, and J. E. Cruz Apr. 1987 49 p
(PB87-210233; NBS/TN-1309) Avail: NTIS HC A03/MF A01; also available SOD HC $2.50 as 003-02800-2 CSCL 20N

The theoretical basis and test procedures are described for horizontally polarized dipole calibrations. Two different techniques and two different test sites were used. The standard antenna method used the calculation of a field strength level, from the response of a simple half wave dipole, to calibrate an antenna. This method was used at an open field site in the frequency range of 25 to 1000 MHz. The standard field method applies the theoretical gain equations of waveguides to determine the field strength level. This latter method was used in an anechoic chamber in the frequency range of 200 to 1000 MHz. Procedures for both techniques are explained and measurement setups are illustrated. Measurement uncertainties are discussed. Sample reports are included for both methods. GRA

N88-11923# Sandia National Labs., Albuquerque, N. Mex.
DUAL S/X-BAND RV ANTENNA
Matthew D. Sena and Ronald D. Bentz 1987 19 p Presented at the Instrumentation Antenna Technology Conference, Atlanta, Ga., 6 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE87-014853; SAND-87-2001C; CONF-8710139-1-Vugraphs)
Avail: NTIS HC A03/MF A01

This paper provides specifications and conceptual design of reentry vehicle antennas. A comparison of the types of shared aperture antennas (single cavity-multiple probe; single cavity-single probe; and multiple cavity-individual probe) is discussed. A description of the multiple cavity configuration and fabrication details is presented. Also shown are tuning conditions, VSWR vs frequency plots, isolation vs frequency plots, radiation patterns, and environmental requirements. DOE

N88-11924# LuTech, Inc., Lafayette, Calif.
THE EFFECTS OF CORONA ON CURRENT SURGES INDUCED ON CONDUCTING LINES BY EMP: A COMPARISON OF EXPERIMENT DATA WITH RESULTS OF ANALYTIC CORONA MODELS
J. P. Blanchard, F. M. Tesche, and B. W. McConnell (Oak Ridge National Lab., Tenn.) Sep. 1987 125 p
(Contract DE-AC05-84OR-21400)
(DE87-014970; ORNL/Sub-85-27461/1) Avail: NTIS HC A06/MF A01

An experiment to determine the interaction of an intense electromagnetic pulse (EMP), such as that produced by a nuclear detonation above the Earth's atmosphere, was performed in March, 1986 at Kirtland Air Force Base near Albuquerque, New Mexico. The results of that experiment have been published without analysis. Following an introduction of the corona phenomenon, the reason for interest in it, and a review of the experiment, this paper discusses five different analytic corona models that may model corona formation on a conducting line subjected to EMP. The results predicted by these models are compared with measured data acquired during the experiment to determine the strengths and weaknesses of each model. DOE

N88-11925*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS INFORMATION NETWORK (LINK): BACKGROUND AND OVERVIEW
Roger R. Schulte Nov. 1987 34 p
(NASA-TM-100162; E-3724; NAS 1.15:100162) Avail: NTIS HC A03/MF A01 CSCL 17B

The NASA Lewis Research Center supports many research facilities with many isolated buildings, including wind tunnels, test cells, and research laboratories. These facilities are all located on a 350 acre campus adjacent to the Cleveland Hopkins Airport. The function of NASA-Lewis is to do basic and applied research in all areas of aeronautics, fluid mechanics, materials and structures, space propulsion, and energy systems. These functions require a great variety of remote high speed, high volume data communications for computing and interactive graphic capabilities. In addition, new requirements for local distribution of intercenter video teleconferencing and data communications via satellite have developed. To address these and future communications requirements for the next 15 yrs, a project team was organized to design and implement a new high speed communication system that would handle both data and video information in a common lab-wide Local Area Network. The project team selected cable television broadband coaxial cable technology as the communications medium and first installation of in-ground cable began in the summer of 1980. The Lewis Information Network (LINK) became operational in August 1982 and has become the backbone of all data communications and video. Author

N88-11926# European Space Agency, Paris (France).
A CONFORMAL AIRCRAFT PHASED ARRAY ANTENNA FOR AIRPLANE-SATELLITE COMMUNICATION IN THE L BAND
Georg Splitt and Hans Forster Jun. 1987 94 p Transl. into ENGLISH of Eine Konforme Flugzeug-Array-Antenne mit Schwenkbarer Strahlungscharakteristik zur Satellitenkommunikation im L-Band (Oberpfaffenhofen, Fed. Republic of Germay, DFVLR), Sep. 1986 Original language document was announced as N87-26259
(ESA-TT-1057; DFVLR-FB-86-47; ETN-87-90876) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 34

A medium gain antenna was developed for direct reception of the MARECS satellite. The antenna system is conformal with the outer skin of the airplane. It was designed as a phased-array system consisting of six individual elements placed in a vertical row. The radiation pattern can be moved in elevation, and can thus be pointed towards the satellite. The halfwidth in elevation direction is 17 deg arc, and in azimuthal direction 20 deg arc. The measurements show a gain between 9 and 10.8 dBi, depending on the lobe, and an efficiency of 65%. The suppression of the mirror reflection by the antenna diagram is between -20 and -25 dB. ESA

N88-11927 Iowa State Univ. of Science and Technology, Ames.
AN ANTENNA ARRAY PROCESSING SYSTEM FOR MULTIPLE SOURCE BEARING ESTIMATION Ph.D. Thesis
John Finney Aurand 1987 144 p
Avail: Univ. Microfilms Order No. DA8716738

The application of array signal processing to angle-of-arrival (AOA) estimation of multiple plane waves was examined. The proposed direction-finding system integrates several algorithms in a cohesive arrangement to exploit their mutually similar structures. The modified forward-backward linear prediction (MFBLP) spectral analysis method of Tufts and Kumaresan was used to obtain high spatial resolution, and the eigenanalysis which is central to its operation provides an excellent point of entry for a procedure to

estimate the number of plane waves detected by the array. Two algorithms were presented for determining the spatial frequencies of the incoming plane waves, based on the MFBLP method. Statistical processing of the bearing estimates from a number of array snapshots was then used to maintain accuracy and precision in noisy array environment. This utilizes both analytical and Monte Carlo computer simulation. The statistical precision is shown to be related to the effective aperture of the antenna array, revealing the degradation in performance as the angle-of-arrival approaches endfire. Dissert. Abstr.

N88-11928# National Bureau of Standards, Gaithersburg, Md. Center for Manufacturing Engineering.
ELECTROMAGNETIC SCATTERING BY A THICK STRIP ON A HALF-SPACE Final Report
E. Marz Jun. 1987 74 p
(PB87-227096; NBS/TN-1236) Avail: NTIS HC A04/MF A01; also available SOD HC $3.50 as 003-003-02808-8 CSCL 20N

The problem of the determination of the scattered fields from an incident plane monochromatic electromagnetic wave on a strip of finite thickness of a half-space is reduced to the numerical solution of integral equations for auxiliary fileds defined on the interfaces. These fields are chosen so as to minimize their number. The derivation of the integral equations is given for a perfectly conducting stip on a perfectly conducting half-space, for a dielectric (or other homogeneous material) on a dielectric half-space, and for a dielectric strip on a half-space of a different dielectric material. The vector FORTRAN programs written to carry out these calculations are briefly discribed, and sample outputs are shown. GRA

N88-11929# Illinois Univ., Urbana. Coordinated Science Lab.
THE ROLE OF SPREAD SPECTRUM IN PACKET RADIO NETWORKS
Michael B. Pursley Jan. 1987 21 p
(Contracts DAAG28-84-K-0088; N00014-84-C-0149)
(AD-A184511; ARO-21576.9-EL) Avail: NTIS HC A03/MF A01 CSCL 17B

This paper is devoted to an examination of the key features of spread-spectrum signaling in packet radio networks. The multiple-access capability, capture, and anti-multipath capability of spread spectrum are the principal topics, and the basic features of spread spectrum that enable it to provide these capabilities are illustrated. The interaction between the spread-spectrum signaling and the network protocols is discussed. Methods for performance evaluation are reviewed, and analytical results on the multiple-access capability of spread spectrum are presented. GRA

N88-11930# IIT Research Inst., Chicago, Ill.
COMPILATION OF 1986 ANNUAL REPORTS OF THE NAVY ELF (EXTREMELY LOW FREQUENCY) COMMUNICATIONS SYSTEM ECOLOGICAL MONITORING PROGRAM, VOLUME 1 Annual Progress Report, Jan. - Dec. 1986
Jul. 1987 449 p
(Contract N00039-84-C-0070)
(AD-A184561; IITRI-E06549-38-Vol-1) Avail: NTIS HC A19/MF A01 CSCL 06G

This is the fifth compilation of annual reports for the Navy's ELF Communications System Ecological Monitoring Program. This report documents the progress of the following studies: Herbaceous Plant Cover and Tree Studies; Litter Decomposition and Microflora; and The Effects of Exposing the Slime Mold Physarum Polycephalum to Electromagnetic Fields. GRA

N88-11931# IIT Research Inst., Chicago, Ill.
COMPILATION OF 1986 ANNUAL REPORTS OF THE NAVY ELF (EXTREMELY LOW FREQUENCY) COMMUNICATIONS SYSTEM ECOLOGICAL MONITORING PROGRAM, VOLUME 2 Annual Progress Report, Jan. - Dec. 1986
Jul. 1987 344 p
(Contract N00039-84-C-0070)
(AD-A184562; IITRI-E06549-38-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 06G

(AD-A184562; IITRI-E06549-38-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 06G

The U.S. Navy is conducting a long-term program to monitor for possible effects from the operation of its Extremely Low Frequency (ELF) Communications System to resident biota and their ecological relationships. This report documents progress of the following studies: soil amoeba; soil and litter arthropoda and earthworm studies; biological studies on pollinating insects: megachilid bees; and small vertebrates: small mammals and nesting birds. GRA

N88-11932# IIT Research Inst., Chicago, Ill.
COMPILATION OF 1986 ANNUAL REPORTS OF THE NAVY ELF (EXTREMELY LOW FREQUENCY) COMMUNICATIONS SYSTEM ECOLOGICAL MONITORING PROGRAM, VOLUME 3 Annual Progress Report, Jan. - Dec. 1986
Jul. 1987 418 p
(Contract N00039-84-C-0070)
(AD-A184563; IITRI-E06549-38-Vol-3) Avail: NTIS HC A18/MF A01 CSCL 06G

This is the fifth compilation of annual reports for the Navy's Extremely Low Frequency (ELF) Communications System Ecological Monitoring Program. This report documents the progress of the following studies: aquatic ecosystems, wetland studies, and bird species and communities. GRA

N88-11933# Georgetown Univ., Washington, D.C. Dept. of Psychology.
RECOGNITION OF ISOLATED NON-SPEECH SOUNDS Final Report, 1 Mar. 1986 - 31 May 1987
James A. Ballas 31 May 1987 13 p
(Contract N00014-86-K-0243; RR0-4209)
(AD-A184600; Rept-87-1-ONR) Avail: NTIS HC A03/MF A01 CSCL 20A

Six experiments were completed and analyzed. These studies addressed the role of uncertain causation in the identification of sounds. In particular, the experiments examined the hypothesis that identification takes longer as the number of alternative causes of the sound increases. Issues related to this hypothesis were also investigated. Summaries of these experiments are included. GRA

N88-11934# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFICIENCY ANALYSIS OF AIRBORNE ELECTRONIC COUNTERMEASURES (ECM) SYSTEMS
Yiting Zhang 21 Aug. 1987 23 p Transl. into ENGLISH from Hangkong Xuebao (China), v. 7, no. 5, Oct. 1986 p 452-460
(AD-A184606; FTD-ID(RS)T-0559-87) Avail: NTIS HC A03/MF A01 CSCL 17D

Along with the development of electronic countermeasures, the evaluation of the efficiency of airborne electronic countermeasure systems has become a question to which people have paid greater and greater attention. This article initially makes an analysis of the importance of the evaluation of efficiency and then proceeds to carry out an analysis and calculations making use of methods from operations research. It also makes use of methods relating to queueing theory in order to solve for airborne platform penetration probability and survival probability. Using the methods of game theory, it makes an analysis of the effects of the means of application of electronic countermeasures on systems efficiency. Finally, through the analysis of an electronic countermeasures combat situation, it presents a method for the calculation of airborne platform utilization factors. GRA

N88-11935# National Telecommunications and Information Administration, Boulder, Colo.
MILLIMETER-WAVE STUDIES OF MOIST AIR Final Report, Oct. 1984 - Mar. 1987
Hans J. Liebe 1 Jun. 1987 84 p
(Contract MIPR-ARO-107-86)
(AD-A184681; ARO-21677.7-GS) Avail: NTIS HC A05/MF A01 CSCL 04A

The near-millimeter region of the spectrum (NMMW: 0.1-1 THz) is an active area for research. Possible applications lie in short-range communications, radar, radiometry, and radio astronomy. Atmospheric effects of transmission and emission dominate performance simulations and the complex refractivity N provides a measure of the interactions between radiation and the atmospheric propagation medium. A reliable N-model allows calculation of frequency-dependent rates for delay (real part) and attenuation (imaginary part) based on measurable meteorological variables. Dry air and atmospheric water vapor are major millimeter-wave absorbers; so are suspended droplets (haze, fog, cloud) and precipitation water drops that emanate from the vapor phase. Laboratory research and analytical studies have been conducted with the primary purpose of understanding NMMW attenuation and delay rates. GRA

N88-11936# Naval Postgraduate School, Monterey, Calif.
THE DESIGN AND TESTING OF AN ANALOG OPTICAL COMMUNICATION LINK CAPABLE OF THE SIMULTANEOUS TRANSMISSION OF FOUR FREQUENCY DIVISION MULTIPLEXED AUDIO SIGNALS M.S. Thesis
Michael S. Silvers Jun. 1987 82 p
(AD-A184695) Avail: NTIS HC A05/MF A01 CSCL 17B

A Communication Link featuring the analog transmission of four simultaneous Frequency Division Multiplexed audio signals, via optical means, was designed, constructed, and experimentally tested. Low cost and common components were utilized throughout the system. Active filter techniques were employed and extended to uncommonly high frequencies. Fidelity of the recovered wave forms proved to be exceptionally high with crosstalk between channels of less than -50 dB. GRA

N88-11937# Stanford Telecommunications, Inc., Reston, Va.
MULTI-CHANNEL COMMUNICATIONS SYSTEM ANALYZER Final Report, Aug. 1985 - Jan. 1987
Robert J. Kleinhenz Jun. 1987 50 p
(Contract F30602-85-C-0089)
(AD-A184756; STI/E-TR-870109; RADC-TR-87-74) Avail: NTIS HC A03/MF A01 CSCL 17B

The Multi-Channel Communications System Analyzer (MCCSA) is a computer controller for a general communications test bed. The MCCSA consists of two or more PC AT style microcomputers, connected by a Local Area Network (LAN), off-the-shelf interfaces that permit connections to the test bed, a custom component called the High Speed Serial Data Comparator (HSSDC) to handle data channels up to 50 Mbps, and a combination of custom and off-the-shelf software that controls the experiment, aids in experiment definitions, and performs post-experiment analyses. The MCCSA is capable of injecting 50 Mbps test data streams onto the test bed, capturing two 50 Mbps data streams from the test bed, aligning the two captured streams, comparing them for discrepancies (errors), compressing the results of the comparison, and storing the results on magnetic tape. The MCCSA also supports a facility that permits it to respond (in real-time) to events happening on the test bed and to record the event (and time) for use in creating the post-experiment chronology and in analyzing the experiment. The MCCSA response to test bed events is user programmable and can serve as a basis for all types of open-loop/closed loop experiments. GRA

N88-11938# Sandia National Labs., Albuquerque, N. Mex.
A NEW METHOD FOR MEASURING WAVEGUIDE PROPAGATION LOSSES
P. J. Brannon 1987 6 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract DE-AC04-76DP-00789)
(DE87-011305; SAND-87-1614C; CONF-8708110-14) Avail: NTIS HC A02/MF A01

We report a refinement of a previously reported method for measuring propagation losses in single-mode optical waveguides. The method as previously described applies to isotropic materials (glass); corrections are necessary when anisotropic materials, such as $LiNbO_2$, are used. This report describes the method and indicates two means for estimating the corrections for anisotropic materials. DOE

N88-11939# Sandia National Labs., Albuquerque, N. Mex.
COUPLING AND ABSORPTION PHENOMENA IN SEMICONDUCTOR-CLAD DIELECTRIC OPTICAL WAVEGUIDES
R. F. Carson and T. E. Batchman (Virginia Univ., Charlottesville.) 1987 15 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987 Prepared in cooperation with Virginia Univ., Charlottesville.
(Contract DE-AC04-76DP-00789)
(DE87-013446; SAND-87-0160C; CONF-8708110-17) Avail: NTIS HC A02/MF A01

Unique propagation characteristics arise from the coupling of light between the lossless modes of a dielectric waveguide and the lossy modes supported by an absorptive cladding layer such as a semiconductor. These effects occur because the propagating lightwave couples into a variety of modes that exist in the semiconductor-clad waveguide. Properties such as cladding thickness, refractive index, and absorption level greatly affect modes of the clad waveguide. Such mode effects are due to periodic coupling between the dielectric layer and the semiconductor cladding. The resulting characteristics suggest use in various device applications. Here, we characterize the periodic coupling effect and how it creates unique modes in the clad waveguide structure. We also describe how the refractive index and absorption of the cladding work together to influence the properties of those modes. DOE

N88-11940# Howard Univ., Washington, D. C. Office of Satellite Communications.
THE BLACK COLLEGE SATELLITE TELECOMMUNICATIONS NETWORK PLANNING IN SUPPORT OF ENERGY-RELATED COLLABORATIVE RESEARCH Final Report
Oct. 1986 28 p
(Contract DE-FG01-85MI-10075)
(DE88-000182; DOE/MI-10075/T1) Avail: NTIS HC A03/MF A01

Four interrelated phases constituted this 12-month effort: planning, system test, system shakedown and system implementation. Objective was to determine and test the most feasible satellite telecommunications network configuration in support of HBCU (historically black college/university) principal investigators conducting research in the energy sciences. This report outlines the accomplishments of that planning effort, indicates potential uses of the operational network and specifies resources needed to effectively mobilize widespread use of the system by HBCU scientists. DOE

N88-11941# Air Force Geophysics Lab., Hanscom AFB, Mass.
ESTIMATES OF SATELLITE EHF COMMUNICATION OUTAGES DUE TO ATTENUATION BY RAIN
Paul Tattelman, Richard W. Knight, and Kathryn G. Scharr 5 Mar. 1987 39 p
(AD-A183969; AFGL-TR-87-0081; AFGL-ERP-970) Avail: NTIS HC A03/MF A01 CSCL 20N

This report provides estimates of outage frequencies, durations, and probabilities at eight United States locations for a satellite EHF communication system employing a frequency of 30 GHz and a fade margin of 15 dB. Ten years of 1-min rain rates at each location were used in conjunction with a attenuation model to make the estimates. One-min rates are recognized as most practical for these calculations, but are ordinarily unreadable from original recordings. Analyses of the 1-min rain rates and outage estimates for elevation angles of 10, 30, 50, and 70 deg are presented. GRA

N88-11942# Naval Postgraduate School, Monterey, Calif.
PERFORMANCE EVALUATION OF A HALF-WAVE RESONANT SLOT ANTENNA OVER PERFECT GROUND USING NEC (NUMERICAL ELECTROMAGNETIC CODE) M.S. Thesis
Constantinos Theofanopoulos Mar. 1987 55 p
(AD-A184004; NPS-62-87-011) Avail: NTIS HC A04/MF A01 CSCL 09A

Present and future trends in shipboard antenna designs have as an objective, antennas which are or will be survivable in combat environments, integrable in ship's superstructures, low in profile and compact. This thesis investigates the performance characteristics of a 7 by 0.2 meter slot antenna, which is cut into a rectangular bulkhead, the bulkhead being a section of the superstructure of an average ship. This slot antenna was modeled using the Numerical Electromagnetic Code. Input impedances, radiation patterns and near fields inside the slot are presented. The reason for conducting this performance evaluation is to determine if this approach to survivable antennas is feasible enough to be implemented in future ship designs. GRA

N88-11943# Washington Univ., St. Louis, Mo. Electronic Systems and Signals Research Lab.
DELAY-DOPPLER RADAR IMAGING Semiannual Progress Report No. 2, 1 Dec. 1986 - 30 May 1987
Donald L. Snyder 30 May 1987 111 p
(Contract N00014-86-K-0370)
(AD-A184165) Avail: NTIS HC A06/MF A01 CSCL 17I

The goal of this project is to formulate and investigate new approaches for forming images of radar targets from spotlight-mode, delay-Doppler measurements. These measurements could be acquired with a high-resolution radar-imaging system operating with an optical or radio frequency carrier. Two approaches are under study. The first is motivated by an image-reconstruction algorithm used in radionuclide imaging called the confidence-weighted algorithm. The second is one based on more fundamental principles which starts with a mathematical model that accurately describes the physics of an imaging radar-system and then uses statistical-estimation theory with this model to derive processing algorithms. Spotlight-mode high-resolution radar-imaging relies upon the relative motion between the transmitter, target, and receiver. The target is illuminated by a series of transmitted pulses. The return for each pulse is a superposition of reflections from various locations on the target, with each location affecting the pulse by introducing both a delay and a Doppler shift. The returns are processed to produce an image of the target. GRA

N88-11944*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ALLOTMENT PLANNING CONCEPT AND RELATED COMPUTER SOFTWARE FOR PLANNING THE FIXED SATELLITE SERVICE AT THE 1988 SPACE WARC
Edward F. Miller, Ann O. Heyward, Denise S. Ponchak, Rodney L. Spence, Wayne A. Whyte, Jr., and John E. Zuzek Nov. 1987 12 p Presented at the Global Telecommunications Conference, Tokyo, Japan, 15-18 Nov. 1987; sponsored by IEEE
(NASA-TM-100244; E-3777; NAS 1.15:100244) Avail: NTIS HC A03/MF A01 CSCL 17B

Described is a two-phase approach to allotment planning suitable for use in establishing the fixed satellite service at the 1988 Space World Administrative Radio Conference (ORB-88). The two phases are (1) the identification of predetermined geostationary arc segments common togroups of administrations, and (2) the use of a synthesis program to identify example scenarios of space station placements. The planning approach is described in detail and is related to the objectives of the confernece. Computer software has been developed to implement the concepts, and a complete discussion on the logic and rationale for identifying predetermined arc segments is given. Example scenarios are evaluated to give guidance in the selection of the technical characteristics of space communications systems to be planned. The allotment planning concept described guarantees in practice equitable access to the geostationary orbit, provides flexibility in implementation, and reduces the need for coordination among administrations. Author

N88-11945*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A STATISTICAL RAIN ATTENUATION PREDICTION MODEL WITH APPLICATION TO THE ADVANCED COMMUNICATION TECHNOLOGY SATELLITE PROJECT. PART 2: THEORETICAL DEVELOPMENT OF A DYNAMIC MODEL AND APPLICATION TO RAIN FADE DURATIONS AND TOLERABLE CONTROL DELAYS FOR FADE COUNTERMEASURES
Robert M. Manning Dec. 1987 101 p
(NASA-TM-100242; E-3866; NAS 1.15:100242) Avail: NTIS HC A06/MF A01 CSCL 17B

A dynamic rain attenuation prediction model is developed for use in obtaining the temporal characteristics, on time scales of minutes or hours, of satellite communication link availability. Analagous to the associated static rain attenuation model, which yields yearly attenuation predictions, this dynamic model is applicable at any location in the world that is characterized by the static rain attenuation statistics peculiar to the geometry of the satellite link and the rain statistics of the location. Such statistics are calculated by employing the formalism of Part I of this report. In fact, the dynamic model presented here is an extension of the static model and reduces to the static model in the appropriate limit. By assuming that rain attenuation is dynamically described by a first-order stochastic differential equation in time and that this random attenuation process is a Markov process, an expression for the associated transition probability is obtained by solving the related forward Kolmogorov equation. This transition probability is then used to obtain such temporal rain attenuation statistics as attenuation durations and allowable attenuation margins versus control system delay. Author

N88-11727 Intespace, Toulouse (France).
IRRADIATION TESTING [ESSAIS D'IRRADIATION]
G. Boures *In* CNES, Space Environment Technology Apr. 1987 p 613-630 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11731 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ELECTROMAGNETIC COMPATIBILITY (EMC) PHENOMENA AND PREVENTION OF THE EFFECTS
L. Inzoli *In* CNES, Space Environment Technology Apr. 1987 p 681-693 (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11881# Joint Publications Research Service, Arlington, Va.
RADAR ECCM'S NEW AREA: ANTI-STEALTH AND ANTI-ARM
Nengjing Li *In its* JPRS report: Science and Technology. China (date) 1-14 (SEE N88-11880 03-31) 14 Jul. 1987 Transl. into ENGLISH from Dianzi Xuebao (Beijing, Peoples Republic of China), v. 15, no. 2, Mar. 1987 p 98-104 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

N88-11882# Joint Publications Research Service, Arlington, Va.
RELAXATION EFFECT OF STARK SPLIT LEVELS FOR TWO-LEVEL SYSTEM INTERACTING WITH SYMMETRICAL STRONG RESONANT BICHROMATIC FIELD Abstract Only
Fuzi Yang and Yizhuang Xu *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 15 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 3, Mar. 1987 p 193-199 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

N88-11884# Joint Publications Research Service, Arlington, Va.
HEIGHT PROFILE INVERSION OF IONOSPHERIC MOVEMENT FROM OBSERVED PARAMETERS OF HF RADIO ECHOES Abstract Only
Weixing Wan and Jun Li *In its* JPRS report: Science and

Technology. China 14 Jul. 1987 p 19 Transl. into ENGLISH from Kongjian Kexue Xuebao (Beijing, Peoples Republic of China), v. 7, no. 2, Apr. 1987 p 85-94 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

N88-11900# Joint Publications Research Service, Arlington, Va.
NEW PHYSICAL EXPLANATION OF PHASE-CONJUGATE WAVES PRODUCED IN BACKWARD STIMULATED SCATTERING
Guangsheng He, Dun Liu, and Songhao Liu *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 21-28 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 13, no. 10, 20 Oct. 1986 p 618-622 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-12150# Centre National d'Etudes Spatiales, Toulouse (France).
SIGNAL TO NOISE RATIOS
Gerard Begni *In its* SPOT 1: First In-Flight Results 1987 p 57-61 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12151# Centre National d'Etudes Spatiales, Toulouse (France).
DETECTOR NORMALIZATION
Marc Leroy *In its* SPOT 1: First In-Flight Results 1987 p 63-69 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N88-11946# National Bureau of Standards, Gaithersburg, Md.
CENTER FOR ELECTRONICS AND ELECTRICAL ENGINEERING TECHNICAL PROGRESS BULLETIN COVERING CENTER PROGRAMS, JANUARY TO MARCH 1987 WITH 1987 CEEE EVENTS CALENDAR
E. J. Walters Jul. 1987 26 p
(PB87-224648; NBSIR-87/3589) Avail: NTIS HC A03/MF A01 CSCL 09C

This is the eighteenth issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the CEEE Technical Progress Bulletin covers the first quarter of the calendar year 1987. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication. GRA

N88-11947# National Bureau of Standards, Gaithersburg, Md. Semiconductor Electronics Div.
RADC/NBS (ROME AIR DEVELOPMENT CENTER/NATIONAL BUREAU OF STANDARDS) WORKSHOP. MOISTURE MEASUREMENT AND CONTROL FOR MICROELECTRONICS (4)
Didier Kane, Benjamin A. Moore, and E. Jane Walters Jun. 1987 343 p Workshop held in Gaithersburg, Md., 12-14 Nov. 1986 Sponsored in part by RADC, Griffiss AFB, N.Y.
(PB87-224614; NBSIR-87/3588) Avail: NTIS HC A15/MF A01 CSCL 09C

The fourth workshop on Moisture Measurement and Control for Microelectronics served as a forum on moisture and/or materials reliability problems and on ways to control them or measure their extent. Twenty-two presentations are included which contain detailed information on hermeticity measurement and definition; development of standard packages for mass spectrometric calibrations; moisture interaction with various materials; and techniques that can be used to measure moisture microelectronics. It was clear from several presentations in the workshop that a very systematic approach is needed when organic materials are involved; all the variables must be identified and studied one at a time. This is the key to lot-to-lot reproducibility, materials selection, and control; hence a better reliability at the design phase will decrease the need for testing; hence the cost, thus resulting in a greater satisfaction to the customer. GRA

N88-11948*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
THE ac POWER SYSTEM TESTBED Final Report
J. Mildice and R. Sundberg Nov. 1987 138 p
(Contract NAS3-24399)
(NASA-CR-175068; NAS 1.26:175068) Avail: NTIS HC A07/MF A01 CSCL 09C

The object of this program was to design, build, test, and deliver a high frequency (20 kHz) Power System Testbed which would electrically approximate a single, separable power channel of an IOC Space Station. That program is described, including the technical background, and the results are discussed showing that the major assumptions about the characteristics of this class of hardware (size, mass, efficiency, control, etc.) were substantially correct. This testbed equipment was completed and delivered and is being operated as part of the Space Station Power System Test Facility. Author

N88-11949*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
HOLLOW CATHODE PLASMA COUPLING STUDY, 1986 Annual Report, 1 Aug. 1985 - 1 Aug. 1986
Paul J. Wilbur Dec. 1986 84 p
(Grant NAG9-120)
(NASA-CR-171985; NAS 1.26:171985) Avail: NTIS HC A05/MF A01 CSCL 09C

The electron collection and emission characteristics of a simple hollow cathode contactor, an extended anode hollow cathode contactor supplied by JSC, and a ring cusp magnetic field contactor are presented and the effects of discharge power and argon or xenon expellant flowrate on these characteristics are examined. All of the contactors are shown to exhibit good electron emission performance over a wide range of discharge power and expellant type and flowrate. Good electron performance is shown to be more difficult to achieve. Results suggest that the extended anode and ring cusp contactors should perform satisfactorily to electron emission currents beyond 1000 mA and electron collection currents beyond 500 mA. All contactors performed better on xenon than argon. A general theory of plasma contactor operation in both the electron collection and electron emission modes, which describes the current-limiting effects of space-charge phenomena is given. This current-limiting and collecting phenomenon is shown to be a function of driving potential differences and emitting and collecting surface radius ratio for the case of a spherical geometry. Discharge power did not appear to influence the electron collection current substantially in the experiments so it is suggested in light of the model that the contactors are generally not limited by their ion production capabilities under conditions at which they were tested. Author

N88-11950# Lawrence Livermore National Lab., Calif.
ELECTRONICS ENGINEERING THRUST AREA REPORT, FY86
P. Phelps, ed., M. Genin, ed., J. Hymer, ed., K. Essary, ed., C. Middleton, ed., B. Kirvel, ed., and P. Adye, ed. Jun. 1987
214 p
(Contract W-7405-eng-48)
(DE87-014616; UCRL-53700-86) Avail: NTIS HC A10/MF A01

The Electronics Engineering Department of Lawrence Livermore National Laboratories has identified six specific engineering technologies areas, calling for special attention. The six areas

reported on in the present report are: Diagnostics and Microelectronics Engineering; Modeling and Simulation; Remote Sensing, Image, and Signal Engineering; Microwave and Pulsed Power Engineering; Computer Technologies; and Dynamic Systems and Control. Six analytics were prepared for the areas covered in this report. DOE

N88-11951# Brookhaven National Lab., Upton, N. Y.
SHORT-PULSE HIGH-CURRENT-DENSITY PHOTOEMISSION IN HIGH ELECTRIC FIELDS
J. Fischer and T. Srinivasan-Rao 1987 14 p Presented at the Workshop on New Developments in Particle Acceleration Techniques, Orsay, France, 29 Jun. 1987
(Contract DE-AC02-76CH-00016)
(DE87-014909; BNL-40224; CONF-8706147-7) Avail: NTIS HC A03/MF A01

Presented are experimental results of photoemission studies on thin wires of gold-coated tungsten, held at surface fields in the range of 10 to the 6th to 3 x 10 to the 8th power V/m, and illuminated by 10 ps long, 4.66 eV photon laser pulses. The wire cathodes arranged coaxially in an anode experienced a surface-field enhancement of 100 to 1000 over the applied voltage. Obtained are current densities exceeding 10 kA/sqcm from a 50 micron diameter wire, from a (50 x 400) sq micron area, under partially space-change-limited conditions. The quantum efficiency for emission-limited cases was in the range of 10 to the -5 power. For these cases results using 50 micron and 4 micron diameter wires indicated linear dependence of charge density with optical energy density. The emission also scaled linearly with the emitting area. For surface fields above 3 x 10 to the 7th power V/m, a twofold enhancement of emission was observed for a tenfold increase in the field. DOE

N88-11952# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
COMPUTERIZED SYSTEM FOR STUDIES ON CREEP OF IRRADIATED MATERIALS IN THE BR-10 REACTOR. CONTROL SYSTEM FOR ELECTRIC MOTOR
V. A. Fazkullin and A. S. Kruglov 1986 13 p In RUSSIAN
(DE87-702888; FEI-1780) Avail: NTIS (US Sales Only) HC A03/MF A01

A system providing programmed control of a three-phase synchronous electric motor is described. The system permits control of the rotational speed in the 0-600 rev./min when angular position is preadjusted. It is supplied with technical means for controlling the rotor angular position, torque and number of revolutions. The system can be used as a subsystem of an automatic-control system. DOE

N88-11953# Deutsche Bundespost, Darmstadt (West Germany).
DEVELOPMENT OF STANDARD CELLS IN NMOS TECHNOLOGY FOR THE DESIGN OF DIGITAL INTEGRATED CIRCUITS
Josef Kraus and Gerhard Schuch Jan. 1987 47 p In GERMAN; ENGLISH summary
(FI-62-TB-6; ETN-87-90569) Copyright Avail: NTIS HC A03/MF A01

Buffer circuits were investigated and optimized with respect to power consumption and delay times using the simulation program SPICE 2G.6. The circuits are intended for use in a standard cell design of some hundred cells. Two driving structures were selected and used as a basis for the development of a cell library containing simple gates, 1 bit adders, and master-slave flip flops. The cells were realized as standalone circuits in a 3 micron MMOS technology, and their functionality was tested. An 8 bit quantizer was generated using an automated placement and routing program in order to test the cells in a larger circuit. ESA

N88-11954# Portsmouth Polytechnic (England). Dept. of Electrical and Electronic Engineering.
A DESIGN-PHILOSOPHY FOR GROUNDING AND INTER-UNIT WIRING
J. W. E. Jones Sep. 1985 11 p
(EMCR-20/85; BR101170; ETN-87-90986) Avail: NTIS HC A03/MF A01

A design philosophy to ensure electromagnetic compatibility of a system is outlined. The properties normally attributed to ground plane are challenged. System units are shielded in accordance with a topological view of shielding design. Requirements for interunit wiring within this approach are listed. ESA

N88-11955# Portsmouth Polytechnic (England). Dept. of Electrical and Electronic Engineering.
DISCUSSIONS IN SUPPORT OF THE DESIGN-PHILOSOPHY FOR GROUNDING AND INTER-UNIT WIRING
J. W. E. Jones Sep. 1985 24 p
(EMCR-21/85; BR101171; ETN-87-90987) Avail: NTIS HC A03/MF A01

Ground planes, electromagnetic shielding, the reduced performance of braided shields relative to continuous metal sheet, and the problems of calculating cable-to-cable coupling in designing for electromagnetic compatibility are discussed. ESA

N88-11956# Portsmouth Polytechnic (England). Dept. of Electrical and Electronic Engineering.
ASSESSMENT OF EXISTING SPECIFICATIONS AGAINST THE DESIGN-PHILOSOPHY FOR GROUNDING AND INTER-UNIT WIRING (EMCR 20/85)
J. W. E. Jones Nov. 1985 17 p
(EMCR-22/85; BR101172; ETN-87-90988) Avail: NTIS HC A03/MF A01

Twelve specifications for aircraft avionics are studied in the light of the design-philosophy of Jones (1985). Conflicts are listed. Jones' approach appears to be more satisfactory. ESA

N88-11957# Portsmouth Polytechnic (England). Dept. of Electrical and Electronic Engineering.
ALTERNATIVES TO THE TECHNIQUES IMPLICIT IN THE DESIGN PHILOSOPHY, AND THE PENALTIES IN PERFORMANCE ASSOCIATED WITH THEM
J. W. E. Jones Feb. 1986 59 p
(EMCR-31/85; BR101173; ETN-87-90989) Avail: NTIS HC A04/MF A01

The proposals in Jones' (1985) grounding and interunit wiring design philosophy are taken, and alternatives (simpler or more commonly adopted) are assessed. In all cases an attempt is made to offer a theoretical justification. In many cases quantitative figures are offered for the reduction in performance associated with the alternatives. ESA

N88-11958# European Space Agency, Paris (France).
LOSS MEASUREMENT OF 3-PORT FERRITE SWITCHES IN THE 90 GHz RANGE
Wolfgang Huettl and Manfred Weisser Sep. 1987 61 p Transl. into ENGLISH of Daempfungsmessungen an 3-Tor-Ferritschaltern im 90-GHz-Bereich (Oberpfaffenhofen, Federal Republic of Germany) Original language document was previously announced as N87-26268
(ESA-TT-1054; DFVLR-Mitt-86-23; ETN-87-91121) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 23

The transmission characteristics of 3-port reciprocal switches for a radiometer in the 90 GHz range were measured. The operation of ferrite switches following the Faraday rotation principle is explained. The measurement procedure and the estimation of measurement accuracy are described. The data of stop-band attenuation measurements and band-pass attenuation measurements are shown. ESA

N88-11959# Hughes Research Labs., Malibu, Calif.
ULTRA-LOW POWER DIGITAL FILTER Final Report, Oct. - May 1983
J. G. Nash and G. R. Nudd Jul. 1987 33 p
(Contract N66001-82-C-0504)

(AD-A184485; NOSC-TD-1114) Avail: NTIS HC A03/MF A01 CSCL 12A

This report describes a study of techniques for building an ultra-low power digital filter. Finite impulse response (FIR), chip-to-chip communications, and multiplier and adder accumulators are discussed. GRA

N88-11960# Hughes Research Labs., Malibu, Calif.
INTEGRATED CIRCUIT DESIGN Final Report, Dec. 1983 - Apr. 1984
V. S. Wong and J. Gringberg Jun. 1987 62 p
(Contract N66001-84-C-0104)
(AD-A184486; NOSC-TD-1099) Avail: NTIS HC A04/MF A01 CSCL 09A

This report describes the results of a study on the chip design of a low-power filter, using state-of-the-art CMOS technology. The filter is for speech applications and is specified to have 1024 type with programmable weights and linear phase. The chip implementation is to have a word length of 8 to 12 bits and consume a maximum of 2.0 mA at 3.6V. Included are current capabilities of CMOS/SOS/bulk, technology, and in particular, the Hughes VHSIC CMOS process. The architecture of the filter is discussed and estimates are made for the power consumption, speed, device count, and projected chip size of the filter implementation. A comparison of a multiple tape and a single tape implementation of the filter is also presented in terms of power consumption and operational speed. GRA

N88-11961# California Univ., Berkeley. Engineering Research Center.
ELECTRONIC SYSTEM RELIABILITY AND EFFECTIVENESS Final Report, 10 Apr. 1985 - 9 Apr. 1987
Richard E. Barlow 3 Aug. 1987 5 p
(Contract N00014-85-K-0384)
(AD-A184522) Avail: NTIS HC A02/MF A01 CSCL 14B

This research contract was motivated by the Naval Air System Center's desire to obtain efficient computational methods for evaluating the reliability of avionics systems with built-in-test (BIT). The methodology in use in 1985 was based on Markov modelling. Unfortunately this methodology involves an unacceptably large number of states and the attendant computations require exponential running time in the number of states. Network reliability research at Berkeley had shown that efficient algorithms are available for special classes of network problems. GRA

N88-11962# California Univ., Berkeley. Electronics Research Lab.
RESEARCH IN MONOLITHIC SIGNAL-PROCESSING CIRCUITS Final Report, 1 May 1984 - 30 Apr. 1987
R. G. Meyer and D. O. Pederson 22 Jun. 1987 12 p
(Contract DAAG29-84-K-0043)
(AD-A184680; ARO-20691.5-EL) Avail: NTIS HC A03/MF A01 CSCL 09A

A new wideband, low-noise bipolar current amplifier has been devised, fabricated and tested. A bandwidth of 184 MHz and input noise of 46 nA rms were achieved. A new low-noise wideband NMOS pre-amplifier was synthesized, fabricated and tested. This yielded 750 MHz bandwidth with 5.5 dB noise figure. New techniques were generated for the realization of very general MOS programmable function synthesizers. GRA

N88-11963# Sandia National Labs., Albuquerque, N. Mex. Inorganic Process Div.
THE DEVELOPMENT OF DIAGNOSTIC FUSES
W. R. Conley Dec. 1986 17 p
(Contract DE-AC04-76DP-00789)
(SAND86-0395) Avail: NTIS HC A03/MF A01

Summarized is the development effort resulting in the fabrication of passive diagnostic devices for underground testing. These devices are currently being used to measure the energy content of electrical pulses induced in cables by X-ray radiation. Author

N88-11964# Sandia National Labs., Albuquerque, N. Mex.
THE LPX (LONG PULSE EXPERIMENT) FACILITY
J. W. Ginn, D. N. Hendricks, M. C. Clark, and M. T. Buttram 1987 18 p Presented at the IEEE International Conference on Plasma Science, Washington, D.C., 1 Jun. 1987
(Contract DE-AC04-76DP-00789)
(DE87-010493; SAND-87-0482C; CONF-8706133-1-Abst) Avail: NTIS HC A02

The load is investigated on the Long Pulsed eXperiment (LPX) facility consisting of a magnetically-insulated, line-limited, saturated parapotential-flow diode. In particular, the scaling of the saturated parapotential flow into the microsecond time regime is examined. Key issues include plasma closure and the presence of ion contamination leading to bipolar flow. View graph data are provided. DOE

N88-11965# Argonne National Lab., Ill.
POST-TEST ANALYSES OF AQUEOUS BATTERIES DEVELOPED FOR ELECTRIC PROPULSION Summary Report, Jan. 1985 - Sep. 1986
J. F. Miller, J. J. Marr, and J. A. Smaga Jul. 1987 67 p
(Contract W-31-109-eng-38)
(DE88-000655; ANL-87-33) Avail: NTIS HC A04/MF A01

This document is a summary of the activities conducted on post-test examination of aqueous electric-vehicle batteries from January 1985 to September 1986. The post-test analyses were conducted to determine the causes of performance degradation (e.g., capacity decline, power loss, self-discharge) in lead-acid and nickel/iron batteries. For the lead-acid batteries, the primary causes of capacity decline were generally found to be morphological changes in the positive active material, corrosion of the positive electrode grid, and loss of contact between the active material and grid in the positive electrode. For the nickel/iron batteries, the primary factors responsible for performance degradation were transport of iron through the separator to the nickel electrode and loss of contact between the active materials and current collector. These results have permitted more accurate assessments of current technical progress in development of aqueous electric-vehicle batteries and have helped to direct future R and D efforts. DOE

N88-11966*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT PROGRESS IN SPACE PHOTOVOLTAIC SYSTEMS
Henry W. Brandhorst, Jr., Dennis J. Flood, and Irving Weinberg Oct. 1987 13 p Presented at the 3rd International Photovoltaic Science and Engineering Conference, Tokyo, Japan, 3-6 Nov. 1987; sponsored by the Japan Soc. of Appl. Phys., Inst. of Elec. Engineers of Japan and the Foundation for the Advan. of International Science
(NASA-TM-100208; E-3807; NAS 1.15:100208) Avail: NTIS HC A03/MF A01 CSCL 09C

Key issues and opportunities in space photovoltaic research and technology relative to future NASA mission requirements and drivers are addressed. Examples are given of space missions and/or operational capabilities on NASA's planning horizon presenting major technology challenges to the use of photovoltaic power generation in space. The status of cell R and D and the performance goals to be met by space photovoltaic power systems to remain competitive are described. Author

N88-11967# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
EFFECTS OF PRESSURE FLUCTUATIONS ON NICKEL ELECTRODES
Albert H. Zimmerman 30 Apr. 1987 40 p
(Contract F04701-85-C-0086)
(AD-A184293; TR-0086A(2945-01)-2; SD-TR-87-42) Avail: NTIS HC A03/MF A01 CSCL 09A

The rapidly fluctuating pressure environment that exists in today's nickel-hydrogen battery cells during high rate charge discharge operation can potentially act as an important source of stress to the active materials in the nickel electrodes. This study

examines the coupling between the rapidly fluctuating pressure environment of hte nickel hydrogen cell and degradation of the nickel electrodes arising from expansion and contraction of the active materials. A model is developed to describe this coupling, and the sensitivity of the coupling to the parameters in the model is analyzed. The model is used to determine modes of nickel hydrogen cell operation for which the pressure environment is particularly critical in terms of potential degradation. The results indicate that cell operation involving rapid cycling or quite large dynamic operating pressure ranges may cause significant stress to the nickel electrodes, and may be an important component in degradation and failure rates. Finally, cell tests are suggested that should allow the effect of the nickel-hydrogen cell pressure environment on performance to be determined. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-11968# Smith (A. M. O.), San Marino, Calif.
TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMICS PANEL SYMPOSIUM ON AERODYNAMIC AND RELATED HYDRODYNAMIC STUDIES USING WATER FACILITIES
A. M. O. Smith, J. W. Slooff, and A. Roshko (California Inst. of Tech., Pasadena.) Aug. 1987 10 p
(AGARD-AR-225; ISBN-92-835-1556-0) Copyright Avail: NTIS HC A02/MF A01

The results of aerodynamic investigations performed in water facilities were examined and reviewed. These facilities included water tunnels, towing channels, and stationary tanks. It was observed that tne use of water as a medium for both aerodynamic and hydrodynamic testing is gradually gaining wider acceptance. This meeting allowed specialists to gather and discuss their results, compare techniques, and find solutions to problems. Author

N88-11969* Universities Space Research Association, Columbia, Md. Science and Engineering Directorate.
COMPUTATION OF TURBULENT FLOWS USING AN EXTENDED k-EPSILON TURBULENCE CLOSURE MODEL Interim Report
Y.-S. Chen and S.-W. Kim Oct. 1987 27 p
(Contract NAS8-35918)
(NASA-CR-179204; NAS 1.26:179204) Avail: NTIS HC A03/MF A01 CSCL 20D

An extended kappa-epsilon turbulence model is proposed and tested with successful results. An improved transport equation for the rate of dissipation of the turbulent kinetic energy, epsilon, is proposed. The proposed model gives more effective response to the energy production rate than does the standard kappa-epsilon turbulence model. An extra time scale of the production range is included in the dissipation rate equation. This enables the present model to perform equally well for several turbulent flows with different characteristics, e.g., plane and axisymmetric jets, turbulent boundary layer flow, turbulent flow over a backward-facing step, and a confined turbulent swirling flow. A second-order accurate finite difference boundary layer code and a nearly second-order accurate finite difference elliptic flow solver are used for the present numerical computations. Author

N88-11970# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
SPECIAL COURSE ON MODERN THEORETICAL AND EXPERIMENTAL APPROACHES TO TURBULENT FLOW STRUCTURE AND ITS MODELLING
Aug. 1987 263 p Course held in Rhode-St.-Genese, Belgium, 16-20 Mar. 1987; sponsored by the von Karman Inst. and AGARD
(AGARD-R-755; ISBN-92-835-0430-5) Copyright Avail: NTIS HC A12/MF A01

The large eddy concept in turbulent modeling and techniques for direct simulation are discussed. A review of turbulence modeling is presented along with physical and numerical aspects and applications. A closure model for turbulent flows is presented and routes to chaos by quasi-periodicity are discussed. Theoretical aspects of transition to turbulence by space/time intermittency are covered. The application to interpretation of experimental results of fractal dimensions and connection of spatial temporal chaos are reviewed. Simulation of hydrodynamic flow by using cellular automata is discussed. For individual titles, see N88-11971 through N88-11978.

N88-11971# Stanford Univ., Calif. Dept. of Mechanical Engineering.
FUNDAMENTALS OF TURBULENCE FOR TURBULENCE MODELING AND SIMULATION
W. C. Reynolds *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 66 p (For primary document see N88-11970 03-34)
Copyright Avail: NTIS HC A12/MF A01

A brief review is given of fluid flow fundamentals pertinent to turbulence. Extensive use is made of the Cartesian tensor summation convention, where repeated indices imply that the terms containing them must be summed over all possible coordinate indices. Author

N88-11972# Electricite de France, Chatou. Lab. National d'Hydraulique.
TURBULENCE MODELLING THROUGH ONE POINT CLOSURES-APPLICATIONS-ENLIGHTENING BY LARGE EDDY SIMULATION
D. Laurence *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 34 p (For primary document see N88-11970 03-34)
Copyright Avail: NTIS HC A12/MF A01

Reynolds stress and Low Re models for the modelling of inhomogeneous flows are considered. They are shown to provide satisfactory predictions for engineering flows. Near wall and buoyancy effects are also included. Results of large eddy simulations are used as guidance to the standard one point closures, especially for data that cannot be obtained by experiment. Author

N88-11973# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. of Aerothermodynamics.
HOMOGENEOUS TURBULENCE TWO-POINT CLOSURES AND APPLICATIONS TO ONE-POINT CLOSURES
B. Aupoix *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 47 p (For primary document see N88-11970 03-34)
Copyright Avail: NTIS HC A12/MF A01

Homogeneous, i.e., translation invariant, turbulence is discussed. Homogeneous turbulence is an ideal situation in which the mean field is unaffected by the turbulent motion, so that the turbulent motion can be studied solely with a prescribed mean field. Such a flow can nearly be achieved in very simple experimental set-ups. Author

N88-11974# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique.
DYNAMICS AND ROUTES TO CHAOS FROM QUASIPERIODICITY
M. Dubois *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 17 p (For primary document see N88-11970 03-34)
Copyright Avail: NTIS HC A12/MF A01

One of the routes leading to deterministic chaos is the route through the quasiperiodicity; the simplest one involves the presence of two oscillators, whose dynamics may become chaotic by the increase of the amount of the non-linearities between them. Though this dynamic is generally related to nonlinear dynamic systems, it may be found in hydrodynamical flows as soon as the increase of a control parameter initiates the appearance of periodic behaviors. So, in the following, the physical examples will be taken from Rayleigh-Benard experiments, which provide good illustrations of quasiperiodic behaviors in dissipative systems. Author

N88-11975# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique.

A DETERMINISTIC APPROACH TO TURBULENCE: CHAOS IN RAYLEIGH-BENARD CONVECTION

P. Berge *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 30 p (For primary document see N88-11970 03-34)

Copyright Avail: NTIS HC A12/MF A01

Various aspects of chaos in Rayleigh-Benard convection are discussed. Basic concepts concerning dissipative dynamical systems, a definition of chaos, a brief introduction to bifurcations, reconstruction of phase space and quasiperiodicity are among the topics covered. R.J.F.

N88-11976# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique.

TRANSITION TO TURBULENCE VIA SPATIO-TEMPORAL INTERMITTENCY

Paul Manneville *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 18 p (For primary document see N88-11970 03-34)

Copyright Avail: NTIS HC A12/MF A01

A scenario of transition to turbulence specific to large aspect ratio systems is presented. Starting with simulations on a model chosen for its relevance to the field of convective instabilities, researchers characterized the spatio-temporal intermittent phase. They examined the transition process having recourse to simpler systems: coupled map lattices. This process appeared to involve the propagation of an information, laminar/turbulent which seemed stochastic though it was generated by a deterministic dynamics. Author GR

N88-11977# Istituto Nazionale di Ottica, Florence (Italy).

DETERMINATION OF FRACTAL DIMENSION, CONNECTION OF SPACE AND TEMPORAL CHAOS AND APPLICATION TO EXPERIMENTAL RESULTS

S. Ciliberto *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 15 p (For primary document see N88-11970 03-34)

Copyright Avail: NTIS HC A12/MF A01

Experiments on time dependent behavior of a horizontal fluid layer, heated from below, that is Rayleigh-Benard convection, are discussed. It is shown that time dependent regimes are characterized by the presence of either traveling waves or localized oscillations. These spatio temporal regimes turn out to be similar to those observed in numerical simulations of Kuramoto-Shivanshisky and Kuramoto-Velarde partial differential equations. Experimental evidence that the properties of the chaotic regimes depend on space coordinates is given. Experiments on surface wave instabilities where the competition between two spatial patterns produces time dependent behavior and chaos are discussed. The results of this experiment are in good agreement with a low dimensional model obtained from Navier-Stokes equations. Author

N88-11978# Brussels Univ. (Belgium). Faculte des Sciences.

LATTICE GAS HYDRODYNAMICS

Jean Pierre Boon and Alain Noullez *In* Advisory Group for Aerospace Research and Special Course on Modern Theoretical and Experimental Approaches to Turbulent Flow Structure and its Modelling Aug. 1987 27 p (For primary document see N88-11970 03-34)

Copyright Avail: NTIS HC A12/MF A01

The motivation for using a lattice gas to simulate hydrodynamics stems from the idea that the details of the microscopic properties should be unimportant to the macroscopic behavior of the fluid. So, whether the fictitious microworld one uses is a caricature of a real fluid does not matter as long as it produces correct hydrodynamics. In order to answer the question of whether the lattice gas hydrodynamics meets the goal of producing correct hydrodynamics, the constitutive elements are built up to construct a lattice gas and a model system is put to work. Computational aspects of hydrodynamic simulations are reviewed. Author

N88-11979# Los Alamos National Lab., N. Mex.

VIBRATIONAL SPECTROSCOPY OF SHOCK-COMPRESSED FLUID N2 AND O2

S. C. Schmidt, D. S. Moore, M. S. Shaw, and J. D. Johnson 1987 5 p Presented at the 5th Topical Conference of the American Physical Society on Shockwaves in Condensed Matter, Monterey, Calif. 20 Jul. 1987

(Contract W-7405-eng-36)

(DE87-013138; LA-UR-87-2272; CONF-870753-60) Avail: NTIS HC A02/MF A01

Single-pulse, multiplex, Coherent Anti-Stokes Raman Scattering (CARS) was used to observe the vibrational spectra of liquid N2 shock-compressed to several pressures and temperatures up to 41 GPa and 5200 K and liquid O2 shock-compressed to several pressures and temperatures up to 10 GPa and 1000 K. For N2, the experimental spectra were compared to synthetic spectra calculated using a semiclassical model for CARS intensities and estimated vibrational frequencies, peak Raman susceptibilities and Raman line widths. The question of excited state populations in the shock-compressed state is addressed. DOE

N88-11980# Los Alamos National Lab., N. Mex.

THE EVOLUTION OF HOBO

R. A. Clark Apr. 1987 7 p Presented at the Workshop on Particle Methods in Fluid Dynamics and Plasma Physics, Los Alamos, N. Mex., 13 Apr. 1987

(Contract W-7405-eng-36)

(DE87-014742; LA-UR-87-2613; CONF-8704168-2) Avail: NTIS HC A02/MF A01

HOBO is a free-Lagrangian hydrodynamics code which has been under development at Los Alamos for several years. It was based on free-Lagrangian tracer points and finite difference approximations to the equations of motion for fluid flow. This method is reviewed briefly here. The use of an independent time step at each point is also described. This technique increases the speed of the code by factors of 10 to 20. How the code has been modified to achieve energy and momentum conservation and how this effects the independent time step is also included, as well as the explicit tracking of material interfaces. DOE

N88-11981# Los Alamos National Lab., N. Mex.

FLIP (FLUID-IMPLICIT-PARTICLE): A LOW-DISSIPATION, PARTICLE-IN-CELL METHOD FOR FLUID FLOW

J. U. Brackbill, D. B. Kothe, and H. M. Ruppel 1987 24 p Presented at the Workshop on Particle Methods in Fluid Dynamics and Plasma Physics, Los Alamos, N. Mex., 13 Apr. 1987

(Contract W-7405-eng-36)

(DE87-014745; LA-UR-87-2897; CONF-8704168-3) Avail: NTIS HC A03/MF A01

Since convective transport is the largest source of computational diffusion, FLIP (Fluid-Implicit-Particle) eliminates convection, and uses instead a Lagrangian formulation. In FLIP, as in PIC, particles represent the fluid: a grid is used only to calculate interactions among particles. FLIP is an adaptation to fluid flows of the implicit moment method for plasma simulation. The particles carry coordinates, momentum, mass and energy,

everything necessary to describe the fluid. Using the particle data, Lagrangian moment equations solved on a grid advance the particle variables from time step to time step. An adaptive grid and implicit time differencing extend the method to singular and low-speed flows. Aspects of FLIP's properties are illustrated by calculations of the Rayleigh-Taylor instability, an unstable, subsonic stream, and a supersonic jet. The results demonstrate FLIP's applicability to the many problems where low dissipation is crucial to correct modeling. DOE

N88-11982# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
POINT VORTEX DYNAMICS: RECENT RESULTS AND OPEN PROBLEMS
Hassan Aref, James B. Kadtke, Ireneusz Zawadzki, Laurence J. Campbell, and Bruno Eckhardt (Kernforschungsanlage, Juelich, West Germany) 1987 11 p Presented at the IUTAM Symposium on Vortex Motion, Tokyo, Japan, 28 Sep. 1987
(Contract W-7405-eng-36)
(DE87-014759; LA-UR-87-2850; CONF-8709125-1) Avail: NTIS HC A03

The concept of point vortex motion, a classical model in the theory of two-dimensional, incompressible fluid mechanics, was introduced by Helmholtz in 1858. Exploration of the solutions to these equations has made fitful progress since that time as the point vortex model has been brought to bear on various physical situations: atomic structure, large-scale weather patterns, vortex street wakes, vortex lattices in superfluids and superconductors, etc. The point vortex equations also provide an interesting example of transition to chaotic behavior. We give a brief historical introduction to these topics and develop two of them in particular to the point of current understanding: steadily moving configurations of point vortices; and collision dynamics of vortex pairs. DOE

N88-11983# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
HEAT TRANSFER IN LAMINAR FLOW FOR MASS INLET INTO AN ANNULAR CHANNEL
A. I. Groshev, P. T. Zubkov, V. V. Khudasko, and V. P. Yugov 1986 10 p In RUSSIAN
(DE87-702980; FEI-1798) Avail: NTIS (US Sales Only) HC A02/MF A01

The results of numerical calculations of temperature fields, pressure gradient, local Nusselt numbers in an annular channel at constant temperature on the inner surface at different parameters of mass inlet through the external surface are described. The conclusion is made that varying the mass inlet parameter one can control hydrodynamics and the temperature field along the channel length and across the channel. DOE

N88-11984# Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik und Energiesysteme.
A TRANSIENT MODEL FOR THERMAL DETONATION Ph.D. Thesis
Konstantinos Karachalios Apr. 1987 221 p In GERMAN; ENGLISH summary
(IKE-2-75; ISSN-0173-6892; ETN-87-90570) Avail: NTIS HC A10/MF A01

A transient model for the description of vapor explosions was developed on the basis of the thermal detonation theory. The model describes the time evolution of thermal detonation waves due to the energy release within the wave. The fragmentation of the melt leads to a very fast increase of the heat transfer interface area, and thus to a very fast energy transfer from the melt to the coolant. The model calculates the escalation dynamics and the long term behavior of thermal detonation waves depending on the initial and boundary conditions. The transient model shows very good consistency with a steady state model and with large scale experiments. ESA

N88-11985# Stuttgart Univ. (West Germany). Inst. fuer Kernenergetik und Energiesysteme.
ANALYTICAL TREATMENT OF THE MELTING AND SOLIDIFICATION OF LATENT HEAT STORE MATERIALS IN FINNED TUBE GEOMETRIES Ph.D. Thesis [ANALYTISCHE BEHANDLUNG DES SCHMELZENS UND ERSTARRENS VON LATENTWAERMESPEICHERMATERIALIEN IN RIPPENROHRGEOMETRIEN]
Manfred Heinisch Jan. 1987 135 p In GERMAN; ENGLISH summary
(IKE-5-223; ETN-87-90571) Avail: NTIS HC A07/MF A01

The heat transfer in a latent heat store was theoretically investigated using a heat exchanger element with a circumferentially finned tube in which the space between the fins is filled with storage material. An analytical method, employing Green's function, was developed to solve the two-dimensional transient heat conduction problem in inhomogeneous materials with simultaneous phase change. The Fourier heat conduction equation and the boundary conditions at the phase front are simultaneously fulfilled by the final solution, and the initial temperature is independent of a given phase change temperature. Only a very small number of time steps is required. Good agreement with data from the literature and with experiments is found. Diagrams for the design and optimization of latent heat stores with finned tubes were developed. ESA

N88-11986# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
NUMERICAL CALCULATION OF TWO DIMENSIONAL FLUID FLOW WITH STRONG SHOCKS
Bernd Einfeldt and Claus-Dieter Munz Apr. 1987 68 p In GERMAN; ENGLISH summary Sponsored by Deutschen Forschungsgemeinschaft, Fed. Republic of Germany
(KfK-4191; ISSN-0303-4003; ETN-87-90586) Copyright Avail: NTIS HC A04/MF A01

Two-step schemes for the two-dimensional Euler equations of compressible gas dynamics are surveyed. The two-step schemes are second-order accurate on smooth parts of the flow and capture shock waves within one or two interior grid zones without generating spurious oscillations. The numerical results for a converging cylindrical shock wave, a Kelvin-Helmholtz instability, and a shock focusing problem are presented. The procedures are demonstrated to be very efficient in the approximation of two-dimensional compressible flows. ESA

N88-11987# Technische Univ., Clausthal-Zellerfeld (West Germany). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen.
THE AXISYMMETRIC SEALING GAP WITH VARIABLE VISCOSITY. A VARIABLE HYDRAULIC RESISTANCE Ph.D. Thesis [DER ROTATIONSSYMMETRISCHE DICHSPALT MIT VARIABLER VISKOSITAET. EIN VERAENDERLICHER HYDRAULISCHER WIDERSTAND]
M. Sabeur 1986 147 p In GERMAN
(ETN-87-90604) Avail: NTIS HC A07/MF A01

The flow in a rotating sealing gap that in practice is the basic element of axially sliding parts and control elements, was investigated taking into account the temperature dependence of the fluid's viscosity. The assumption of a constant viscosity is found to be reliable for gaps greater than 50 microns. The temperature distribution over the gap width was calculated for different boundary conditions, allowing the dimensioning of hydraulic resistances. Calculations confirm the measured maximum and minimum in the friction moment distribution over the gap width. The results allow computer aided design of networks with hydraulic elements. ESA

N88-11988# Technische Univ., Munich (West Germany). Inst. fuer Thermodynamik und Fluidmechanik.
CALCULATION OF THE THREE DIMENSIONAL FLOW IN THE IMPELLER OF HYDRAULIC TURBOMACHINES USING A FINITE ELEMENT METHOD Ph.D. Thesis [BERECHNUNG DER DREIDIMENSIONALEN STROEMUNG IM LAUFRAD HYDRAULISCHER TURBOMASCHINEN MIT EINEM FINITE-VOLUMENVERFAHREN]
Werner Braitsch 1986 96 p In GERMAN
(ETN-87-90612) Avail: Issuing Activity

A finite volume method was developed for the calculation of the three-dimensional flow in the rotating impeller of hydraulic turbomachines for given geometry and flow boundary conditions. The discretization equations are presented. The variables are the relative velocities and the pressure terms. The discretization equations were solved using an explicit time marching method with a pressure correction to ensure continuity at all times. Satisfactory agreement is found between calculated and measured flow quantities, taking into account simplifications. The advantages of the method are the physically understandable procedure and the unlimited capability of development. The disadvantage is the high requirement of storage capacity and computer time. ESA

N88-11989# Royal Armament Research and Development Establishment, Fort Halstead (England).
STEADY TONATION AND FLAGRATION WAVES IN REACTIVE CONTINUA
C. K. Thornhill 1973 88 p
(RARDE-2/73; BR37555; ETN-87-90978) Avail: NTIS HC A05/MF A01

A theory of steady reaction waves is presented. It applies to all types of steady reaction waves; tonation waves which can only travel at supersonic speeds relative to the undisturbed reactive medium, and flagration waves which may be either subsonic or supersonic. It also applies whether the total reaction in the wave is nett exothermic (detonations, deflagrations) or nett endothermic (intonations, inflagrations). If the term reaction is taken to include exothermic and endothermic phase-changes such as condensation, vaporization, fusion, and solidification, then the theory also includes all steady waves in which such phase-changes are propagated, both of tonation and flagration type. The theory applies to steady reaction waves of finite thickness, and is developed for general fluids, as distinct from particular fluids with simple thermodynamic properties. ESA

N88-11990# Hochschule der Bundeswehr, Munich (West Germany). Lehrstuhl fuer Hydromechanik.
STOCHASTIC MODEL OF THE MOTION OF SUSPENDED PARTICLES IN TURBULENT FLOW
W. Bechteler, H.-B. Kleeberg, H. Teichmann, and H.-J. Vollmers Apr. 1987 240 p In GERMAN; ENGLISH summary Sponsored by Deutschen Forschungsgemeinschaft
(HSBW-Mitt-21/1987; ETN-87-91059) Avail: NTIS HC A11/MF A01

The time averages of the stochastic matrixes were calculated in state space notation enabling the dispersion of particles to be determined in dependence on turbulence and particle parameters. No Monte-Carlo calculations of random walk models are necessary. By multiplications of a linear dispersion equation of the stochastic model, the time varying dispersion coefficient can be calculated also in cases of inhomogenous turbulence. In contrast to the results of Taylor's theory the time varying dispersion coefficient increases slower because the stochastic model uses the correlations of particle positions instead of particle velocity. The dispersion coefficients of fluid points and suspended spheres were calculated from measured turbulence intensities and time scales of turbulence. The stochastic models have to be improved with respect to the used time scales. Time scales of particle movements are more decreased by the crossing trajectory effect than they are increased by the inertia of mass of the suspended spheres. ESA

N88-11991# European Space Agency, Paris (France).
MEASUREMENT OF GAS FLOW VELOCITIES NEAR OBSTACLES: ANALYSIS AND OPTIMIZATION OF AN OPTICAL BARRIER VELOCIMETER. ASSOCIATED SIGNAL PROCESSING
Francoise Clerc Sep. 1987 241 p Transl. into ENGLISH of Mesure des Vitesses dEcoulements Gazeux a Proximite dObstacles: Etude et Optimisation dun Velocimetre a Barriere Optique-Traitement du Signal Associe (Chatillon, France) Original language document was previously announced as N87-26286
(ESA-TT-1056; ONERA-NT-1986-5; ETN-87-91123) Avail: NTIS HC A11/MF A01

Improvements to enhance the performance of optical barrier anemometers as to the approach to the walls are proposed. The study of a detector includes a photomultiplier operating in nominal state, avalanche photodiodes, and a photomultiplier operating in supersaturated state. Statistical processing includes the measurement results obtained on a pilot installation. It is shown that it is possible to approach obstacles to within 0.2 mm. ESA

N88-11992# European Space Agency, Paris (France).
THEORETICAL ANALYSIS OF PRIMARY INSTABILITIES IN THREE DIMENSIONAL BOUNDARY LAYER FLOWS
Heribert Bieler Jul. 1987 132 p Transl. into ENGLISH of Theoretische Untersuchun Ueber Primaere Instabilitaeten in Dreidemensionalen Grenzschichtstroemungen (Goettingen, Fed. Republic of Germany, DFVLR), Jul. 1986 Original language document was announced as N87-26295
(ESA-TT-1063; DFVLR-FB-86-54; ETN-87-91127) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 39

The cross flow instability in negative pressure gradient regions of three-dimensional boundary layers was analyzed using local, linear stability theory. The stability eigenvalue problem was solved, applying a spectral method (Chebyshev collocation). Almost perpendicular to the potential flow direction, propagating low frequency and stationary disturbances are already amplified at low Reynolds numbers, and therefore accentuated with respect to the others. The frequency of the most amplified traveling mode, and the wavelength of the stationary disturbance pattern are in satisfactory agreement with measurements on a swept plate with a pressure-inducing displacement body. ESA

N88-11993# European Space Agency, Paris (France).
FLOW VISUALIZATION ON AN OGIVE-NOSED CIRCULAR CYLINDER BODY AT HIGH INCIDENCE USING THE LASER LIGHT SHEET METHOD
Juergen Kompenhans and Klaus Hartmann Sep. 1987 61 p Transl. into ENGLISH of Stroemungssichtbarmachun an einen Hochangestellten Ogigkreszylinderrumpf mit Hilfe der Laser-Lichtschnittmethode (Goettingen, Fed. Republic of Germany, DFVLR), Nov. 1986 Original language document was announced as N87-26025
(ESA-TT-1066; DFVLR-FB-86-45; ETN-87-91129) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 21

The asymmetric vortex separation on a missile body at high angles of attack was visualized by the laser light sheet method. The development of the vortex structures along the body axis and at different roll positions was recorded on video film. The video film and the corresponding still photos allow a better interpretation of the simultaneously measured pressure distributions. ESA

N88-11994# European Space Agency, Paris (France).
LASER DOPPLER MEASUREMENTS IN A TURBULENT FREE JET
Bernhard Lehmann Sep. 1987 187 p Transl. into ENGLISH of Laser-Doppler-Messungen in einem Turbulenten Freistrahl (Goettingen, Fed. Republic of Germany, DFVLR), Jan. 1987 Original language document was announced as N87-26296
(ESA-TT-1067; DFVLR-FB-86-55; ETN-87-91130) Avail: NTIS

HC A09/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 42

A multidimensional method for the correction of the turbulence-induced statistical velocity bias of laser Doppler (LD) measurements in the highly turbulent shear flow of a circular free jet was developed. The correction method was applied to LD measurement results of a single-component measurement device. The LD results were obtained by fast Fourier transformation analysis, and compared with hot-wire measurements from the same flow field. Techniques for the introduction of optical scatter particles into the flow field result in very different velocity profiles. The features of the profiles can be explained by the existence of a large helical vortex structure which influences the entrainment process. ESA

N88-11995# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Transportfysica.

LINEAR AND NONLINEAR THEORIES OF FLOW THROUGH AN ACTUATOR DISK

A. M. vanderSpek 23 Aug. 1986 133 p

(R-803-A; ETN-87-91310) Avail: NTIS HC A07/MF A01

The basic equations of aerodynamics, and the theory of rotating fluids as applied to actuator disks are introduced. An equation for the Stokes stream function, and an equation for the streamwise change of the Bernoulli equation are derived. Combined they give a single, nonlinear partial differential equation for the stream function. The equation may be solved when the circulation is known. The equation for the stream function is linearized. The full nonlinear problem is tackled by an iterative method. The numerical results indicate stream tube contraction near the axis, while simultaneously the Bernoulli constant decreases. The contraction occurs as a result of positive azimuthal vortex rings on the actuator disk near the axis. The positive azimuthal vorticity induces inward directed radial velocities. This effect is not offset by the strong negative azimuthal vorticity near the tip. ESA

N88-11996 Rhode Island Univ., Kingston.

MECHANICAL AND FLOW EXCITED VIBRATIONS OF ELASTIC PLATES AND CYLINDRICAL SHELLS IN DENSE FLUIDS Ph.D. Thesis

Dong-Jye Li 1986 353 p

Avail: Univ. Microfilms Order No. DA8715334

Mechanical and flow excited vibrations of elastic plates and cylindrical shells in dense fluids are presented. The perturbation method is used to connect the basic equations in fluid mechanics and acoustics. A computer model based on a boundary fitted coordinate transformation is used to solve the two dimensional incompressible viscous time dependent fluid flow problem. Numerical results for flow over vibrating plates and flow across vibrating cylindrical shells are presented. Several fluid acoustic solid interaction problems are addressed using a generic block diagram model. These problems include both viscous and inviscid flows over elastic plates and shells. The emphasis was to determine the near field surface pressure distribution on the elastic vibrators. The surface pressure for the forced vibration of elastic plates in contact with inviscid fluid flow is predicted using time and wavenumber domain approaches. The surface pressure on an elastic plate for the coupled fluid plate problem was addressed through analytical and numerical approaches. The surface pressure on a cylindrical shell with a specified radial excitation without flow is addressed by a modal expansion technique. Dissert. Abstr.

N88-11997 Lehigh Univ., Bethlehem, Pa.

ANALYSIS OF THE MOTIONS AND EFFECTS OF HAIRPIN VORTICES Ph.D. Thesis

Thon-Lon Hon 1987 222 p

Avail: Univ. Microfilms Order No. DA8714670

Various aspects of the motion of hairpin vortices near solid walls are addressed on a theoretical basis. In particular the following topics are of interest: (1) the nature of the evolution of hairpin vortices in a shear flow; (2) the type of flow induced near a wall by a convected hairpin vortex; (3) the character of the viscous response near a wall to the hairpin vortex motion, and (4) the nature of the interaction of two hairpin vortices. A numerical procedure is developed to allow the accurate evaluation of the trajectory of a 3-dimensional vortex for vortices having small cores. First, the integration method is based on a numerical approximation to the Biot-Savart integral; most existing vortex calculation methods have severe stability problems for vortices with small cores. Second, the response is computed for a viscous flow near a wall due to the motion of a hairpin vortex above the wall. The results reveal that a complex, unsteady boundary layer flow develops near the wall which ultimately develops a very strong local outward growth. Dissert. Abstr.

N88-11998 Brown Univ., Providence, R. I.

DYNAMICS OF THE VON KARMAN VORTEX STREET Ph.D. Thesis

Chjan Chin Lim 1987 123 p

Avail: Univ. Microfilms Order No. DA8715530

A complete linear stability analysis of the von Karman vortex is given. The general initial value problem is considered and it is shown that even for the special spacing ratio, arbitrarily small initial data can become arbitrarily large in finite time. The propagation of signals on the vortex trail is treated. A variation of Kelvin's method of stationary phase is used to obtain theoretical wave speeds which are then compared with Tritton's measurements of the velocity of signals on the vortex trail behind a cylinder. The nonlinear dynamics of the vortex trail is considered. Under periodic perturbations (the most unstable being of period two), the von Karman trail is shown to support a rich variety of solutions, e.g., unbounded and also quasi-periodic solutions. In the physical plane these solutions are related to the merging of vortices. A comparison between the theoretical results and recent experimental and numerical work on the evolution of the vortex trail behind bluff objects is made. Dissert. Abstr.

N88-11999 Florida Univ., Gainesville.

NONEQUILIBRIUM FLUCTUATIONS AND TRANSPORT IN SHEARED FLUIDS Ph.D. Thesis

James Francis Lutsko 1986 158 p

Avail: Univ. Microfilms Order No. DA8716019

Hydrodynamic fluctuations in a sheared fluid far from equilibrium are described by means of nonlinear stochastic differential equations. Two models resulting from two different limits of the exact Fokker-Planck equation describing hydrodynamic fluctuations in an arbitrary fluid are presented. The first model results from restricting attention to fluctuations which take place on length scales large with respect to the mean free path. The resulting Navier-Stokes-Langevin equations are specialized to shear flow and the associated linear hydrodynamic models are determined. These are used to calculate the correlations functions of fluctuations around the steady state with the full nonlinear dependence on shear rate necessary for large shear rates. The second model results from the short time limit of the exact Fokker-Planck equation and describes fluctuations even on atomic length scales provided the mean free path is small enough. The linear modes of this model are obtained and it is found that they differ considerably from the long wavelength modes.

Dissert. Abstr.

N88-12000 Iowa State Univ. of Science and Technology, Ames.

APPLICATION OF AN UPWIND ALGORITHM TO THE PARABOLIZED NAVIER-STOKES EQUATIONS Ph.D. Thesis

Scott Leroy Lawrence 1987 98 p

Avail: Univ. Microfilms Order No. DA8716785

A computer code was developed for the solution of the three dimensional parabolized Navier-Stokes (PNS) equations. The code employs a state-of-the-art upwind algorithm to capture strong shock waves. The algorithm developed is implicit, uses finite volumes, and is second order accurate in the crossflow directions. The code is validated through application to several laminar supersonic and hypersonic flows. In two dimensions, calculations were performed for supersonic laminar flow past a flat plate, hypersonic laminar flow into a converging inlet. Results obtained using the algorithm are in excellent agreement with experimental data as

well as with previous numerical calculations. The method was validated for three dimensional flow by computing hypersonic flows past two simple body shapes: a circular cone and a generic all-body hypersonic vehicle. Cone flow solutions were computed at several angles of attack and results are in agreement with experimental data. Results are also presented for the flow past the all-body vehicle at angles of incidence of 0 and 10 deg. Dissert. Abstr.

N88-12001 Cornell Univ., Ithaca, N.Y.
THE DIFFUSION-CONVECTION VORTEX METHOD FOR SOLVING TWO-DIMENSIONAL INCOMPRESIBLE NAVIER-STOKES EQUATION Ph.D. Thesis
Zhi Yun Lu 1987 135 p
Avail: Univ. Microfilms Order No. DA8708949

A new diffusion-convection vortex method is presented and applied to both initial value problems and boundary value problems. Evolution of the vorticity field is directly calculated by simulation with diffusion effects. The continuous vorticity field is discretized into many small vorticies, and the velocity field, differing from usual vortex methods, is solved in fixed Eulerian coordinate system without using the Cloud-in-cell interpolation. Numerical examples show comparison between the present method and other methods, as well as the visualization results for an impulsively started circular cylinder. Dissert. Abstr.

N88-12002 Washington State Univ., Pullman.
MOMENTUM TRANSPORT AND PARTICLE DYNAMICS IN TURBULENT SHEAR FLOWS Ph.D. Thesis
Reiyu Ray Chein 1986 243 p
Avail: Univ. Microfilms Order No. DA8711981

The mechanism of turbulent momentum transport and the associated particle dispersion in basic shear flows was explored. The two-dimensional turbulent mixing layer and the flow behind normal or inclined plates were chosen as the sample flow fields. The effects of the vortex pairing process on the dispersion of particles were examined first. It was discovered that the vortex flow during pairing process shows a distinctively high ability to entrain the particles and to disperse them more than the pre-pairing and the post-pairing flows. The study was then extended to the particle dispersion in a plane mixing layer. The momentum transport mechanisms in a two-dimensional plane mixing layer were also investigated through a discrete vortex method. The calculations show a definite correlation between the passage of a large-scale structure and a turbulent burst in the turbulent momentum flux. Finally, discrete vortex simulations were carried out for flow over normal and inclined plates. Particle dynamics in the upstream and the wake was also investigated. Based on the comparisons of gross and detail features in the wake flow, the numerical simulation closely reproduces the measured results in experiments.
Dissert. Abstr.

N88-12003 Akron Univ., Ohio.
CONJUGATED HEAT TRANSFER FROM A RADIATING FLUID IN A RECTANGULAR CHANNEL Ph.D. Thesis
Mohammad Kassemi 1987 296 p
Avail: Univ. Microfilms Order No. DA8715700

Combined effects of laminar forced convection and two-dimensional radiation in a rectangular channel are investigated. The mathematical model is represented by a set of coupled nonlinear integro-partial differential equations which are solved numerically, using an element-to-node approach. The numerical scheme is ideally suited for combined modes of heat transfer problems which involve isotropic scattering and reflective boundaries. The mathematical model depends on ten important physical parameters. The effect of these dimensionless parameters on the thermal characteristics of the process is systematically investigated. Finally, it is established that the heat transfer characteristics of the medium are drastically altered by the interaction among the modes of heat transfer. In a combined and conjugated heat transfer problem, use of any a priori specified heat transfer coefficients taken from pure convective flows is inadequate and inaccurate. Dissert. Abstr.

N88-12004 Princeton Univ., N. J.
AN EXPERIMENTAL INVESTIGATION OF QUASI-CONICAL SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTIONS Ph.D. Thesis
Roger Lee Kimmel 1987 215 p
Avail: Univ. Microfilms Order No. DA8714910

An experimental investigation of the shock wave/turbulent boundary layer interactions produced by swept compression corners, semicones, and a sharp leading edge fine was conducted at a freestream Mach number of 2.94 and a unit Reynolds number of 6.7 x 10 to the 7th per meter, with ambient stagnation temperature and approximately adiabatic conditions. Mean surface static pressure and surface flow visualization data were obtained for all interactions for the thin boundary layer configuration. Mean flowfield total pressure, static pressure, yaw angle, and a time-resolved surface pressure data were also obtained for a swept corner interaction, a semi-cone interaction, and a sharp fin interaction for the thick boundary layers configuration. Shadowgraphs were used to correlate shock sweep angle in terms of model geometry and Mach number. Results show that the surface pressure and flow visualization for all interactions examined were quasi-conical in nature. Dissert. Abstr.

N88-12005# Columbia Gas System Service Corp., Columbus, Ohio.
DOUBLE-EFFECT ABSORPTION HEAT PUMP, PHASE 3 Final Report, Aug. 1984 - Dec. 1986
F. B. Cook, S. P. Cremean, S. C. Jatana, R. A. Johnson, and N. D. Malcosky 30 Jun. 1987 169 p
(Contract GRI-5084-242-0985)
(PB87-232195; GRI-87/0236) Avail: NTIS HC A08/MF A01 CSCL 20D

The RD&D program has resulted in design, development and testing of a packaged prototype double-effect generator cycle absorption gas heat pump for the residential and small commercial markets. The 3RT heat pump prototype has demonstrated a COPc of 0.82 and a COPh of 1.65 at ARI rating conditions. The heat pump prototype includes a solid state control system with built-in diagnostics. The absorbent/refrigerant solution thermophysical properties were completely characterized. Commercially available materials of construction were identified for all heat pump components. A corrosion inhibitor was identified and tested in both static and dynamic environments. The safety of the heat pump was analyzed by using two analytical approaches. Pioneer Engineering estimated the factory standard cost to produce the 3RT heat pump at $1,700 at a quantity of 50,000 units/year. One United States patent was allowed covering the heat pump technology, and two divisional applications and three Continuation-in-Park Applications were filed with the U.S.P.T.O. Corresponding patent coverage was applied for in Canada, the EEC, Australia, and Japan. Testing of the prototype heat pump is continuing, as are life tests of multiple pump concepts amd long-term dynamic corrosion tests. Continued development and commercialization of gas absorption heat pumps based on the technology are recommended. GRA

N88-12006# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
THE PROCEEDINGS OF THE SYMPOSIUM ON MECHANICS FOR SPACE FLIGHT
Mar. 1987 196 p Symposium held in Tokyo, Japan, 13-15 Nov. 1986
(ISAS-SP-5; ISSN-0288-433X) Avail: NTIS HC A09/MF A01

Papers are presented on the following subjects: interacting vortex rings, dividing vortons, three-dimensional Euler solutions, entrance flow and its transition in a circular pipe, repetitively pulsed laser propulsion rocket, gravitational effects on thermal denaturation process in a biopolymer, Marangoni convection in Bridgman method, effect of void gas lying between fluid slugs in nutation dampers, heat transfer in axially grooved heat pipes, pump assisted heat pipe, nonequilibrium characteristics of nitrogen plasmas appropriate to an AOTV flight, Rayleigh scattering measurements of a freejet with homogeneous condensation,

flowfield through interaction of two parallel two-dimensional freejets, and the root locus method applied to flexural vibration control systems. For individual titles, see N88-12007 through N88-12022.

N88-12007# Ochanomizu Women's Univ., Tokyo (Japan). Faculty of Science.
EXPERIMENTAL STUDY OF INTERACTING VORTEX RINGS
Naoki Izutsu, Koichi Oshima, and Yuko Oshima *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 3-13 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Interactions of vortex rings were experimentally studied by means of hot wire anemometers. Velocity fields were measured in single, two coaxial and two parallel axial vortex rings. The vorticity fields calculated from the obtained data were animated and were quantitatively analyzed in order to explain the interacting mechanism. The results clearly demonstrate the processes of the merging, splitting, crosslinking and decay of the vortical regions. Author

N88-12008# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
NUMERICAL SIMULATION OF THE INTERACTION OF VORTEX RINGS IN VISCOUS FLUID
Chen Han-Lin *In its* The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 15-22 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

The interaction of vortex rings in viscous fluid is simulated numerically by using the finite difference method to solve the Navier-Stokes equation. The numerical method, which uses alternating direction implicit difference, upwind difference and an iterative technique for recovering accuracy and adjusts the calculating domain, is stable, accurate and efficient for analyzing the motion of vortex rings. Simulations were done and the results were obtained for various Reynolds numbers. The simulation shows good coincidence with the experiments. Author

N88-12009# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
THEORY OF DIVIDING VORTONS
Sinzi Kuwabara *In its* The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 23-30 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

The basic equations for vortons in incompressible, inviscid fluid are derived from a pseudo-canonical formulation of three-dimensional vortex motion. The division of vortons and the reduction of meshes of time integration are taken into account. Numerical calculations based on the vorton model are made for the evolution of a connected three-ring (mituwa-shaped) vortex and a vortex ring in a spherical vessel. In the first case, the ring seems to be cut and reconnected to become two rings and the deformed ring in the second case is cut and attaches normally to the surface. Author

N88-12010# Fujitsu Ltd., Tokyo (Japan). Scientific Systems Dept.
ON THE SCHEME DEPENDENCY OF THE THREE-DIMENSIONAL EULER SOLUTIONS
Yoko Takakura, Tomiko Ishiguro, and Satoru Ogawa (National Aerospace Lab., Tokyo, Japan) *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 31-45 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

The modification of the recent total variation diminishing (TVD) schemes with regard to treatment of metric is presented, and the estimation for the TVD schemes and the conventional Beam-Warming scheme is performed by comparing the computational results for the three-dimensional flows about the ONERA-M6 wing with the experimental data. Modified TVD schemes are proved to be reasonable when applied to the three-dimensional Euler equation in general curvilinear coordinates and the characteristics of each scheme have been captured. It was verified for each scheme that it should be made to agree with accuracy of fluxes; otherwise, modification of maintaining freestream should be used. The modified TVD schemes yield excellent solutions with few numerical oscillations for even strong shock waves and a high ability of capturing the leading edge expansion and weak shock waves. The negative side is high cost and inapplicability to three-dimensional problems because weak shock waves are missed. Author

N88-12011# IBM Japan. Technical Education.
NUMERICAL STUDY OF THE ENTRANCE FLOW AND ITS TRANSITION IN A CIRCULAR PIPE (2)
H. Kanda and K. Oshima *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 47-76 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

The experimental data and results of prior investigations lead to defining the problem of the transition from laminar to turbulent flow in a circular pipe. The flow field of a circular pipe is examined with particular emphasis on the entrance and transition length, using a two-dimensional computational scheme. Symmetric disturbances were superimposed on points near the inlet and wall of the pipe. It was found for the first time that the transition length is predicted fairly satisfactorily by the computational simulation. A numerical, finite-difference method is shown to simulate development of the Hagen-Poiseuille flow and transition to turbulent flow. Conclusions are: (1) the turbulence transition occurs only within the entrance region; (2) the transition length decreases as the Reynolds number increases under the same inlet conditions; (3) a good bellmouth lessens disturbances at the inlet and the critical Reynolds number becomes larger; (4) the transition is numerically simulated on the conditions that the aspect ratios of the rectangular mesh system are 2 for Re=2,700 and 1 for Re=10,000 and that the disturbance is given at the point very near the wall of the inlet; and (5) the result of simulation satisfies two theorems of Rayleigh (dependence of the flow stability on laminar velocity profiles). Author

N88-12012# Tokyo Univ. (Japan). Dept. of Aeronautics.
THRUST AND SPECIFIC IMPULSE OF REPETITIVELY-PULSED-LASER PROPULSION ROCKET **c20**
Mengu Cho and Kanji Abe *In its* The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 77-96 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

In order to describe the flow field in a repetitively pulsed laser propulsion rocket nozzle, the detonation wave model and the blast wave model are considered. In the blast wave model the deposition of laser energy is made only at the apex of the cone nozzle. In the detonation wave model the deposition of laser energy is made at the wave front which is sustained by a laser. The similarity method and the finite difference method are used. The specific impulse, thrust and energy conversion efficiency are determined on the basis of the two models. The laser pulse of short duration gives rise to the blast wave, while the laser pulse of long duration gives rise to the detonation wave. The total deposition energy of the laser may be given by (duration time) times (power). If the total energy is the same, the short and strong laser pulse leads to performance higher than the long and weak laser pulse. That is to say, the former excels 1.11 times in the thrust and the specific impulse, and 1.33 times in the energy conversion efficiency compared to the latter. Author

N88-12013# Miyazaki Univ. (Japan). Dept. of Applied Physics.
ESTIMATIONS OF GRAVITATIONAL EFFECTS ON THERMAL DENATURATION PROCESS IN A BIOPOLYMER **c27**
Kanji Etori *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 97-105 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Detailed discussions of the helix-random coil transition in a biopolymer affected by a gravitational field are made by using a one dimensional chain model of polypeptide molecules. With an aim of showing the temperature dependence of the fraction of random-coil residues in a polypeptide, the minimums of free energies for both states of alpha-helix and random coil are calculated by taking the statistical approximation under thermoequilibrium conditions. As a result, positive and negative gravitational effects loading the intermolecular energies of both states in a polypeptide are shown as shifts from the values of the fraction of random-coil residues given by the conventional models which do not include any gravitational term. These shifts are estimated to be the changes from the conventional values for the rate of denaturation in a biopolymer. Author

N88-12014# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
NUMERICAL ANALYSIS OF MARANGONI CONVECTION IN BRIDGMAN METHOD **c29**
Hiroyuki Uchida, Keiichi Kuwahara, and Shintaro Enya *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 107-115 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Natural convection driven by the surface tension, so-called Marangoni convection, was analyzed by using the finite difference method. The result of the preparative computation was compared with Ochiai's experimental and numerical results, showing fairly good agreements. Further analysis was made for the mathematical model of the Bridgman method. It was shown that the vortex center moves from near free surface toward the opposite boundary as the Marangoni number increases. A simple correlation between heat transfer coefficient and Marangoni number was also shown. B.G.

N88-12015# Tokyo Univ. (Japan).
EFFECT OF VOID GAS LYING BETWEEN FLUID SLUGS IN NUTATION DAMPERS
Akimasa Takaichi, Jun Nishimura, and Motoki Hinada *In its* The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 117-126 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Nutation dampers of a partially filled annular type were often installed in satellites to remove their coning motion, if any. It is expected that during the cruising of a satellite the fluid slug in its damper tends to be separated into several owing to the existence of temperature gradient, and this results in the deterioration of its damping characteristics. Under such conditions it is better to mount the damper with offset in the satellite. The increase in kinematic viscosity v of working fluid is also advantageous, but there is little merit in having a large size of inner radius r. Anyway once this phenomenon has occurred, the drastic increase in the damping time is inevitable, so it is most important for the whole damper to be kept uniform in temperature. Author

N88-12016# Mitsubisi Electric Corp., Tokyo (Japan). Central Research Lab.
HEAT TRANSFER PERFORMANCE OF AXIALLY GROOVED HEAT PIPES
Tetsurou Ogushi and Gorou Yamanaka *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 127-139 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Experiments and analysis of the heat transport capability of axially grooved heat pipes are described. The heat pipes were made of aluminum axially grooved extruded pipes and the working fluid was R11. The effects of fluid inventory and inclination angle on the capillary pumping limit were investigated. A theoretical model was developed to predict the temperature rise in the evaporator and the heat transfer capability. In this model, the puddling effect, liquid recession into the groove bottom and the heat conduction in the evaporator were taken into consideration and the prediction agreed well with the experimental data. It was found that the temperature at the evaporator end began to increase just after all the grooves dried out at the evaporator end. The flooding limit and the evaporator and condenser film coefficients in the case of the gravity-supported operation were also investigated and compared with the performance of closed two-phase thermosyphons. Author

N88-12017# Toshiba Corp., Tokyo (Japan).
HEAT TRANSFER CHARACTERISTICS OF ARTERIAL HEAT PIPE WITH AXIAL GROOVES
Yoshiro Miyazaki, Shigeto Oshima, and Yukihiko Inoue *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 141-147 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

An arterial heat pipe with axial grooves has a three dimensional network of liquid passages and its heat transfer characteristics are significantly influenced by gravity force. An analytical model for the heat pipe operation under the gravity field was presented. Calculated results using the model predict a wide range of partial dryout regions and it shows a good agreement with experimetal results. Heat transfer characteristics under the zero gravity field are also calculated. It predicts that the maximum heat transport capacity would be higher than that for the gravity field but the range of partial dryout region would be very narrow. Author

N88-12018# Toshiba Corp., Tokyo (Japan).
PUMP ASSISTED HEAT PIPE
Yoshiro Miyazaki and Shigeto Oshima *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 149-154 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

A laboratory model of a pump assisted heat pipe was fabricated and tested. An arterial heat pipe with axial grooves and a gear pump with a magnetic coupling were developed for the model. The test was carried out successfully. The reasonable thermal conductance was obtained so far as the necessary working fluid flow rate is supplied. The necessary flow rate exceeds the theoretical one and the excess flow rate increases as the heat load increases. Author

N88-12019# Gunma Univ., Maebashi (Japan). Faculty of Engineering.
NONEQUILIBRIUM CHARACTERISTICS OF NITROGEN PLASMAS APPROPRIATE TO AN AOTV FLIGHT **c75**
Hiroyuki Shirai *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 155-163 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Nonequilibrium electronic excitations and deexcitations in nitrogen plasmas appropriate to an AOTV flight are studied theoretically. From the given nonequilibrium thermodynamic state variables behind a strong shock wave, the number densities of internal states of a nitrogen atom, nitrogen molecule, and nitrogen ionic molecule are calculated by using the collisional and radiative process theory, in which the effects of heavy particle impacts are included. Based on the results of the nonequilibrium population distributions at various electronic states of each species, emission, and absorption characteristics of the plasmas are calculated. Author

N88-12020# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
RAYLEIGH SCATTERING MEASUREMENTS OF A FREEJET WITH HOMOGENEOUS CONDENSATION
Koji Teshima, Ken-ichi Abe, and Toru Nishino *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 167-173 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

A change of the mean cluster size or mean atom numbers per cluster along the flow axis in a freejet expansion of argon was obtained from the measured intensity of Rayleigh scattering, using calculated values of mass fraction of the condensate. The mean cluster size increases with expansion and seems to approach to a frozen value which was measured in a cluster beam by other direct methods, indicating that the present method is useful for studying the cluster growth process of homogeneous condensation in a rapid expansion flow. Author

N88-12021# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATION AND VISUALIZATION OF A FLOWFIELD BY INTERACTION OF TWO PARALLEL TWO-DIMENSIONAL FREEJETS
Koji Teshima and Hiroyuki Nakatsuji (National Space Development Agency, Tokyo, Japan) *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 175-186 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Flowfields resulted from interaction of two equivalent freejets issued from two parallel two-dimensional sonic nozzles at various nozzle distances and at various values of the stagnation to ambient pressure ratio are investigated numerically and by visualization. A strong shear flow region appears between the two jets, which is observed by visualization, is simulated well by the present calculation. Agreement of the parameters representing the whole structure of the flowfield, such as the location of the interaction point of the inner lateral shock with the outer one, the location of the shock reflection point on the symmetry plane and the deflection angle of each jet by interaction, are very well between the simulation and the experiment so far nearly two-dimensional flows are realized in the experiment. Author

N88-12022# Kyushu Univ., Fukuoka (Japan). Dept. of Aeronautical Engineering.
ON THE ROOT LOCUS METHOD APPLIED TO FLEXURAL VIBRATION CONTROL SYSTEMS **c18**
Norihiro Goto and Shinji Hokamoto *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 187-200 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

Precise attitude and shape control of flexible spacecraft requires active control of flexural vibrations. This work is concerned with the root locus method applied to active vibration control systems for a certain class of flexible bodies. A general characteristic equation is first derived for a feedback system to control flexural vibrations with arbitrary numbers of sensors and actuators. Then it is shown for the first time that the characteristic equation in a determinantal form may be expanded in a mathematically tractable form. The expanded form can show clearly the significance of the colocation condition of sensors and actuators. The characteristic equation in a moving coordinate system is also derived, considering that the control is made using the outputs of onboard sensors. Finally, a numerical study is presented to illustrate a practical procedure of applying the root locus method to flexural vibration control systems. Author

N88-12023# Naval Postgraduate School, Monterey, Calif.
VISUALIZATION OF THE FLOW FIELD AROUND A GENERIC DESTROYER MODEL IN A SIMULATED TURBULENT ATMOSPHERIC BOUNDARY LAYER M.S. Thesis
William K. Bolinger Jun. 1987 57 p
(AD-A184658) Avail: NTIS HC A04/MF A01 CSCL 20D

An experimental flow visualization study was performed on a rectangular block and other elements that could be assembled in the form of a generic destroyer ship model. The purpose of the study was to visually analyze the flow field around the model in a simulated open ocean atmospheric boundary layer. To ensure correct simulation of the atmospheric boundary layer, both velocity profile and longitudinal turbulence intensities were matched. For the actual flow visualization studies, two techniques were used. During the on-body portion of the study, the ultraviolet lighting/fluorescent minitufl technique was used. For the off-body portion, helium bubble system, with a neutral density centrifuge, was utilized. Both techniques produced excellent photographic results and allowed for direct comparison of the flow fields using the two flow visualization techniques. GRA

N88-12024# Naval Postgraduate School, Monterey, Calif.
STRUCTURAL CHARACTERISTICS OF DEAN VORTICES IN A CURVED CHANNEL M.S. Thesis
Randal D. Niver Jun. 1987 63 p
(AD-A184724) Avail: NTIS HC A04/MF A01 CSCL 20D

Dean vortices in a curved channel were studied using flow visualization and a miniature Kiel probe to record total pressure. The channel is 1.27 cm. high by 50.8 cm. wide (0.5 in. x 20.0 in.), aspect ratio of 40 to 1, with a radius of curvature of 60.96 cm. (24.0 in) for the concave surface. Mean velocities within the curve channel were maintained at Dean numbers which ranged from 0 to 250. Smoke injected into the mouth of the channel at Dean numbers from 42 to 218 and locations from 65 deg to 145 deg revealed different types of flow behavior, including numerous pairs of Dean vortices extending from the convex to the concave wall. Different types off flow structures have been categorized as to unsteadiness, height, and symmetry. For each category a map has been constructed which depicts the flow structure observed as a function of Dean number and angular location. These maps and the photographs give an understanding of the flow behavior in the curved channel over a significant range of experimental conditions. Total pressure measurements at a Dean number of 110 and one location (118 deg) were taken. The preliminary results are presented on a contour plot which shows some repeatability across a 2 in. portion of the channel span. These contour plot results are consistent with photographs for the same experimental conditions. Author (GRA)

N88-12025# Naval Postgraduate School, Monterey, Calif.
UNSTEADY FLOW ABOUT CAMBERED PLATES M.S. Thesis
Paul D. Munz Jun. 1987 51 p
(AD-A184725) Avail: NTIS HC A04/MF A01 CSCL 20D

The evolution of a two dimensional, incompressible, rapidly decelerating, time-dependent viscous flow about a sharp-edged camber is simulated through the use of the discrete vortex model. Vorticity is represented by a distribution of discrete point vortices. Each vortex is convected in the velocity field, calculated locally using the Biot-Savart law. The roll-up of the vortex sheets, the distribution of velocity and pressure on the camber, and the drag force are calculated at suitable time intervals for a prescribed time-dependent flow. Experiments are carried out in a vertical water tunnel partly to measure the drag force and partly to record on a video tape the evolution of the wake. The measured and calculated characteristics of the flow, such as the growth of the wake and the forces acting on the camber are found to be in good agreement. Furthermore, the numerical simulation provided a plausible explanation for the cause of parachute collapse, a phenomenon which gave impetus to the numerical and physical experiments described herein. The numerical model developed during the course of the investigation is applicable to any time-dependent flow about two-dimensional cambered plates (circular arcs). Author (GRA)

N88-12026# New York Univ., New York. Courant Inst. of Mathematical Sciences.
A STUDY OF CHAOS AND MIXING IN RAYLEIGH-TAYLOR AND RICHTMYER-MESHKOV UNSTABLE INTERFACES
C. L. Gardner, J. Glimm, J. Grove, O. McBryan, and R. Menikoff Apr. 1987 17 p
(Contract DAAG29-85-K-0188)
(AD-A184751; ARO-22770.6-MA; DOE/ER-03077-278) Avail: NTIS HC A03/MF A01 CSCL 20D

Instabilities of fluid interfaces give rise to entrainment and to a chaotic mixing layer. This report has three purposes. The authors discuss the general features of such chaotic mixing layers, formulate a scientific program for their study and report on their recent progress in carrying out portions of this program. The

Rayleigh-Taylor instability is drived by an inertial or gravitational force accelerating an interface between fluids of differing densities. Thus with the heavy fluid above the lighter fluid a flat (horizontal) interface in a gravitational field is in a position of unstable equilibrium. Small disturbances grow, producing bubbles of light fluid rising in the heavy fluid and spikes - or droplets of heavy fluid falling in the light fluid. The Richtmyer-Meshkov instability is produced by a shock wave hiring an interface (a contact discontinuity or material boundary) separating fluids of differing densities. Assuming a planar shock wave normally incident on an interface slightly perturbed from planar, the initial disturbances in the interface are again unstable, and grow with time. GRA

N88-12027# Copenhagen Univ. (Denmark).
THE DYNAMICS OF BUBBLE GROWTH FOR RAYLEIGH-TAYLOR UNSTABLE INTERFACES
C. L. Gardner, J. Glimm, O. McBryan, R. Menikoff, and D. Sharp May 1987 74 p
(Contract DAAG29-85-K-0188)
(AD-A184752; ARO-22770.7-MA; DOE/ER-03077-282) Avail: NTIS HC A04/MF A01 CSCL 20D

A statistical model is analyzed for the growth of bubbles in a Rayleigh-Taylor unstable interface. The model is compared to solutions of the full Euler equations for compressible two phase flow, using numerical solutions based on the method of front tracking. The front tracking method has the distinguishing feature of being a predominantly Eulerian method in which sharp interfaces are preserved with zero numerical diffusion. Various regimes in the statistical model exhibiting qualitatively distinct behavior are explored. It appears that the parameters in the statistical model can be set from first principles on the basis of comparison with numerical solutions of the full Euler equation. Author (GRA)

N88-12028*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON HELICITY FLUCTUATIONS AND THE ENERGY CASCADE IN TURBULENCE Final Report
Charles G. Speziale Nov. 1987 13 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178403; ICASE-87-69; NAS 1.26:178403) Avail: NTIS HC A03/MF A01 CSCL 20D

Recent conjectures concerning the correlation between regions of high local helicity and low dissipation are examined from a rigorous theoretical standpoint based on the Navier-Stokes equations. It is proven that only the solenoidal part of the Lamb vector omega x u (which is directly tied to the nonlocal convection and stretching of vortex lines) contributes to the energy cascade in turbulence. Consequently, it is shown that regions of low dissipation can be associated with either low or high helicity, a result which disproves earlier speculations concerning this direct connection between helicity and the energy cascade. Some brief examples are given along with a discussion of the consistency of these results with the most recent computations of helicity fluctuations in incompressible turbulent flows. Author

N88-12029*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
COMPARISON OF FLIGHT-MEASURED AND CALCULATED TEMPERATURES ON THE SPACE SHUTTLE ORBITER
Leslie Gong, William L. Ko, Robert D. Quinn, and W. Lance Richards Nov. 1987 75 p
(NASA-TM-88278; H-1384; NAS 1.15:88278) Avail: NTIS HC A04/MF A01 CSCL 20D

Structural temperatures and thermal protection system surface temperatures were measured on the space shuttle during the flight of STS 5. The measured data are compared with values calculated at wing stations 134, 240, and 328 and at fuselage station 877. The theoretical temperatures were calculated using the structural performance and resizing finite element thermal analysis program. The comparisons show that the calculated temperatures are, generally, in good agreement with the measured data. Author

N88-12030*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WAVEFRONT ERROR SENSING
Eldred F. Tubbs 15 Oct. 1986 15 p
(NASA-CR-181504; JPL-D-3722; NAS 1.26:181504; LDR-TM-86-2) Avail: NTIS HC A03/MF A01 CSCL 20D

A two-step approach to wavefront sensing for the Large Deployable Reflector (LDR) was examined as part of an effort to define wavefront-sensing requirements and to determine particular areas for more detailed study. A Hartmann test for coarse alignment, particularly segment tilt, seems feasible if LDR can operate at 5 microns or less. The direct measurement of the point spread function in the diffraction limited region may be a way to determine piston error, but this can only be answered by a detailed software model of the optical system. The question of suitable astronomical sources for either test must also be addressed. M.G.

N88-12031# Montreal Univ. (Quebec). Dept. de Mathematiques et de Statistique.
SOME ASPECTS OF HIGH RESOLUTION NUMERICAL METHODS FOR HYPERBOLIC SYSTEMS OF CONSERVATION LAWS, WITH APPLICATIONS TO GAS DYNAMICS
Paul Arminjon Mar. 1986 96 p Sponsored by F.C.A.C., Quebec
(DMS-86-7) Avail: NTIS HC A05/MF A01

Discussed are several important aspects of finite difference methods for hyperbolic systems of conservation laws, from first-order upwind to second-order TVD schemes based on flux limiters and flux splitting, or on Godunov's method. Particular attention is given to the recent schemes of Sweby, Davis, and Goodman-LeVeque, which are second-order TVD versions of the Lax-Wendroff and Godunov schemes. An essential role is played by Harten's criterion for Total Variation Diminishing schemes. Author

N88-12032# Los Alamos National Lab., N. Mex.
CONSERVATION AND TRANSPORT PROPERTIES OF TURBULENCE WITH LARGE DENSITY VARIATIONS
Didier Besnard, Francis H. Harlow, and Rick Rauenzahn Feb. 1987 59 p
(Contract W-7405-eng-36)
(LA-10911-MS) Avail: NTIS HC A04/MF A01

A turbulence model is developed for flows containing large density gradients but moving with small Mach number. In such cases, the turbulence initiates in regions with the steepest spatial variations in mean density. This model generalizes standard turbulence models and is comprised of transport equations for second-order correlations constructed from fluctuating components of density, velocity and internal energy. From these, instability-driven source terms for turbulence arise naturally. Also exhibited is the effect of nonhomogeneities in the flow on the level of turbulence. Many applications of this model can be envisioned, including meteorology, the study of stratified flow, and the investigation of volcanic plumes formed during eruptions. Author

N88-12033# Lawrence Livermore National Lab., Calif.
PARTICLE VELOCITY AND STRESS GAGE MEASUREMENTS IN SPHERICAL DIVERGING FLOW
D. B. Larson and R. B. Stout Mar. 1987 44 p Presented at the Summer Meeting of the American Society of Mechanical Engineers, Cincinnati, Ohio, 14 Jun. 1987
(Contract W-7405-eng-48)
(DE87-007333; UCRL-96320; CONF-870637-4) Avail: NTIS HC A03/MF A01

Chemical explosions are used to generate spherically diverging stress waves in polymethyl methacrylate(PMMA). Piezoresistance gages of several different designs were placed in the PMMA radially from the spherical energy source. Two basic types of piezoresistance gages were used. One type was placed on backing material and then glued directly to the PMMA while the other type was placed on backing material and then enclosed in a fluid

cavity which was attached to the PMMA. Gages were oriented normal to the direction of the shock front. In order to interpret the piezoresistance gage measurements and to obtain a complete set of data for numerical calculations, particle velocity was also measured at several radial positions from the explosion. In addition to different ytterbium gage designs, a triple material gage that contained ytterbium, manganin, and constantan foils was tested. This gage provided three independent resistivity history signals as output, one from each material. Results from an analysis of piezoresistance gage response in a multicomponent stress-strain field compared well with the experimental measurements for the triple material gage. DOE

N88-12034# Oak Ridge National Lab., Tenn.
DROP FORMATION FROM AN ORIFICE IN AN ELECTRIC FIELD
C. H. Byers and J. J. Perona 1987 23 p Presented at the American Institute of Chemical Engineers Annual Meeting, New York, N.Y., 15 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE87-014405; CONF-871113-2) Avail: NTIS HC A02/MF A01

The use of an electric field to control the formation of small drops at an orifice in a circular disk was investigated. Water drops were formed in a pure cyclohexane continuous phase, in the pre-jetting regime using four different orifice diameters. Because of the application of high potentials (up to 1000 V/cm) and because the orifice plate produced a nonuniform field, drop volumes varied to as little as 20 times smaller than the drop volume for a zero-field case. The drops were ellipsoidal in shape, and droplet eccentricity increased dramatically with field intensity. A mathematical model was developed, based on the potential field between a disk (the orifice plate) and an infinite plate (the grounded screen). The electric force on the drop was calculated from the field intensity at discrete points around the periphery. Values for predicted drop volumes using this model and for experimental drop volumes agreed very well. DOE

N88-12035# Pennsylvania State Univ., University Park.
CONTINUED RESEARCH ON DIRECT CONTACT HEAT EXCHANGERS: EFFECTS OF CRYSTALLIZATION Final Report
H. R. Jacobs Jul. 1987 26 p
(Contract DE-AS07-84ID-12552)
(DE87-014931; DOE/ID-12552/1) Avail: NTIS HC A03

This report describes a preliminary study to determine whether crystallizer schemes could be effectively used in binary geothermal power plants. An industry and literature search was conducted for models that predict potential scale formation. The results indicated that the theoretical models for predicting not only homogeneous nucleation, but also secondary nucleation are suspect. DOE

N88-12036# Integral Technologies, Inc., Westmont, Ill.
MULTIDIMENSIONAL MODELING OF CONVECTIVE HEAT TRANSFER WITH APPLICATION TO I.C. ENGINES Technical Progress Report
Mark J. Jennings and Thomas Morel 25 Sep. 1986 15 p
(Contract DE-AC04-86AL-33183)
(DE87-014983; DOE/AL-33183/T4) Avail: NTIS HC A03/MF A01

The objective of this project has been to develop a more comprehensive understanding of the convective heat transfer process in complex, unsteady turbulent reacting flows, typical of those which occur in internal combustion engines. The specific area of research was representation of heat transfer in detailed multi-dimensional Navier-Stokes models, and modeling of turbulent transport mechanisms. The detailed tasks included a review of relevant prior work. DOE

N88-12037# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
TORSION AS A SOURCE OF EXPANSION IN A BIANCHI TYPE I UNIVERSE IN THE SELF-CONSISTENT EINSTEIN-CARTAN THEORY OF A PERFECT FLUID WITH SPIN DENSITY Final Report, period ending Sep. 1986
James C. Bradas Jun. 1987 22 p
(AD-A184200; AD-E951057; AMSMI/TR-RD-GC-87-3) Avail: NTIS HC A03/MF A01 CSCL 03B

It is shown that that a generalized (or power law) inflationary phase arises naturally and inevitably in a simple (Bianchi Type I) anisotropic cosmological model in the self-consistent Einstein-Cartan gravitation theory with the improved stress-energy-momentum tensor with spin density of Ray and Smalley. This is made explicit by analytical solution of the field equations of motion of the fluid variables. The inflation is caused by the angular kinetic energy density due to spin. The model further elucidates the relationship between fluid vorticity, the angular velocity of the inertially-dragged tetrads, and the precession of the principal axes of the shear ellipsoid. Shear is not effective in damping the inflation. GRA

N88-12038# Dayton Univ., Ohio.
STUDY OF AEROPROPULSION LABORATORY PRESSURE DROP RIG AND RECOMMENDED TEST PROCEDURE Final Report, May - Oct. 1984
M. O. Lawson and J. E. Minardi Nov. 1986 58 p
(Contract F33615-84-C-2411)
(AD-A184333; UDR-TR-84-139; AFWAL-TR-86-2077) Avail: NTIS HC A04/MF A01 CSCL 14B

This report presents the results of a study of a pressure drop rig for measuring pressure drop across samples of foam. In addition, a test procedure and two evaluation programs are presented which reduce test data to standard day conditions so that the results are independent of the test ambient conditions. An analysis of instrument reading error effects is provided to determine their maximum cumulative effect on the assigned value of foam pressure drop. GRA

N88-12039*# Texas A&M Univ., College Station. Turbomachinery Labs.
LOCAL HEAT/MASS TRANSFER AND PRESSURE DROP IN A TWO-PASS RIB-ROUGHENED CHANNEL FOR TURBINE AIRFOIL COOLING Final Report
J. C. Han and P. R. Chandra Sep. 1987 170 p
(Contract NAS3-24227; DA Proj. 1L1-62209-AH-76)
(NASA-CR-179635; NAS 1.26:179635; AVSCOM-TR-87-C-14)
Avail: NTIS HC A08/MF A01 CSCL 20D

The heat transfer characteristics of turbulent air flow in a multipass channel were studied via the naphthalene sublimation technique. The naphthalene-coated test section, consisting of two straight, square channels joined by a 180 deg turn, resembled the internal cooling passages of gas turbine airfoils. The top and bottom surfaces of the test channel were roughened by rib turbulators. The rib height-to-hydraulic diameter ratio (e/D) were 0.063 and 0.094, and the rib pitch-to-height ratio (P/e) were 10 and 20. The local heat/mass transfer coefficients on the roughened top wall and on the smooth divider and side walls of the test channel were determined for three Reynolds numbers of 15, 30, and 60, thousand, and for three angles of attack (alpha) of 90, 60, and 45 deg. Results showed that the local Sherwood numbers on the ribbed walls were 1.5 to 6.5 times those for a fully developed flow in a smooth square duct. The average ribbed-wall Sherwood numbers were 2.5 to 3.5 times higher than the fully developed values, depending on the rib angle of attack and the Reynolds number. The results also indicated that, before the turn, the heat/mass transfer coefficients in the cases of alpha = 60 and 45 deg were higher than those in the case of alpha=90 deg. However, after the turn, the heat/mass transfer coefficients in the oblique-rib cases were lower than those in the transverse rib case. Correlations for the average Sherwood number ratios for individual channel surfaces and for the overall Sherwood number ratios are reported. Correlations for the fully developed friction factors and for the loss coefficients are also provided. Author

N88-11871*# Alabama Univ., Huntsville.
WAKE SHIELD
Tommy Bannister (Wyle Labs., Inc., Huntsville, Ala.) and Gerald R. Karr *In its* Consortium for Materials Development in Space.

Technical Section Sep. 1987 p 94-96 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 20D

N88-11886# Joint Publications Research Service, Arlington, Va.
THREE-DIMENSIONAL CALCULATION IN HIGH SUBSONIC AXIAL COMPRESSOR ROTOR AND ITS COMPARISON WITH L2F VELOCITY MEASUREMENT Abstract Only
Qinghuan Wang *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 32 Transl. into ENGLISH from Gongcheng Rewuli Xuebao (Beijing, Peoples Republic of China), v. 8, no. 2, May 1987 p 119-124 Original language document was announced in IAA as A87-51809 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

N88-11887# Joint Publications Research Service, Arlington, Va.
FINITE ELEMENT ANALYSIS OF THREE-DIMENSIONAL STEADY AND UNSTEADY TEMPERATURE FIELDS (COMPUTATION OF TEMPERATURE DISTRIBUTION OF TURBINE BLADE WITH COMPOSITE COOLING) Abstract Only
Shouli Ji *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 33 Transl. into ENGLISH from Gongcheng Rewuli Xuebao (Beijing, Peoples Republic of China), v. 8, no. 2, May 1987 p 159-165 Original language document was announced in IAA as A87-51815 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N88-12040# National Bureau of Standards, Boulder, Colo. Electromagnetic Technology Div.
LIMITS TO THE PRECISION OF ELECTRO-OPTIC AND MAGNETO-OPTIC SENSORS
G. W. Day, P. D. Hale, M. Deeter, T.E. Milner, and D. Conrad Mar. 1987 123 p Sponsored in part by Bonneville Power Administration, Portland, Oreg., Empire State Electric Energy Research Corp., N.Y. and Electric Power Research Inst., Palo Alto, Calif.
(PB87-212536; NBS/TN-1307) Avail: NTIS HC A06/MF A01; also available SOD HC $6.00 as 003-02801-1 CSCL 14B

The principles of electro-optics and magneto-optic sensors suitable for use in power system applications are reviewed with particular attention to the properties of materials and components that limit the precision of such sensors. Data on a number of materials are collected and presented. For high precision electro-optic sensors, it is recommended that crystals of point symmetry (bar4)3m be used. For high precision magneto-optic sensors, a lead glass with a low stress-optic coefficient is recommended. Choices for other components are also suggested. For both types of sensors, a precision of roughly plus or minum 1 percent over a 100 C temperature range should be attainable. To achieve a precision better than that, it will be necessary to use temperature compensation techniques, several of which are proposed and discussed. GRA

N88-12041# National Bureau of Standards, Gaithersburg, Md. Electrosystems Div.
NBS (NATIONAL BUREAU OF STANDARDS) WIDEBAND SAMPLING WATTMETER Final Technical Note
G. N. Stenbakken, O. B. Laug, T. H. Kibalo, B. A. Bell, and A. G. Perrey May 1987 116 p
(PB87-210324; NBS/TN-1221) Avail: NTIS HC A06/MF A01; also available SOD HC $5.50 as 003-02796-1 CSCL 14B

The design and operation of a wideband sampling wattmeter capable of measuring distorted power signals with fundamental frequencies of 1 Hz to 10 kHz and harmonics up to 100 kHz is described. The microcomputer controlled wattmeter uses asynchronous sampling of the voltage and current signals. The errors associated with this type of operation are discribed, as are various methods of correcting some of these errors. A hardware multiplier-accumulator allows a large number of power signal samples to be integrated for each measurement. Sampling rates are variable up to a maximum of 300 kHz. A direct-memory-access unit is used to capture 4096 samples of both the voltage and current signals. These data are used to calculate the average and rms values of these signals. Schematic diagrams are given of the circuits used in this wattmeter and their operation is described. The software is also described, and flow charts and selected program listings are provided for the programs written in Pascal. The results of calibration of the instrument over the past year are also presented. GRA

N88-12042*# Sverdrup Technology, Inc., Cleveland, Ohio.
PERFORMANCE AND OPERATING ENVELOPE OF IMAGING AND SCATTERING PARTICLE SIZING INSTRUMENTS
Edward A. Hovenac Nov. 1987 15 p Presented at the International Conference on Optical Methods in Flow and Particle Diagnostics, San Diego, Calif., 8-12 Nov. 1987
(Contract NAS3-24105)
(NASA-CR-180859; E-3849; NAS 1.26:180859) Avail: NTIS HC A03/MF A01 CSCL 14B

Scattering and imaging type particle sizing instruments are analyzed in terms of their ability to make accurate determinations of particle size distributions, number density, and total mass. Sources of counting and sizing errors are explained. Ways are described of identifying these errors and how these errors can effect the measurements. Author

N88-12043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF COUNTING ERRORS IN THE PHASE/DOPPLER PARTICLE ANALYZER
John R. Oldenburg Nov. 1987 12 p Presented at the International Congress on Applications of Lasers and Electro-Optics, San Diego, Calif., 11-12 Nov. 1987; sponsored by Laser Inst. of America
(NASA-TM-100231; E-3854; NAS 1.15:100231) Avail: NTIS HC A03/MF A01 CSCL 14B

NASA is investigating the application of the Phase Doppler measurement technique to provide improved drop sizing and liquid water content measurements in icing research. The magnitude of counting errors were analyzed because these errors contribute to inaccurate liquid water content measurements. The Phase Doppler Particle Analyzer counting errors due to data transfer losses and coincidence losses were analyzed for data input rates from 10 samples/sec to 70,000 samples/sec. Coincidence losses were calculated by determining the Poisson probability of having more than one event occurring during the droplet signal time. The magnitude of the coincidence loss can be determined, and for less than a 15 percent loss, corrections can be made. The data transfer losses were estimated for representative data transfer rates. With direct memory access enabled, data transfer losses are less than 5 percent for input rates below 2000 samples/sec. With direct memory access disabled losses exceeded 20 percent at a rate of 50 samples/sec preventing accurate number density or mass flux measurements. The data transfer losses of a new signal processor were analyzed and found to be less than 1 percent for rates under 65,000 samples/sec. Author

N88-12044# Lawrence Livermore National Lab., Calif.
PROGRESS TOWARD A CRYSTAL STREAK CAMERA USING TUNGSTEN BRONZE CRYSTALS FOR THE ELECTROOPTIC MATERIAL
L. F. Jelsma, M. E. Lowry, R. R. Neurgaonkar, W. K. Cory, and H.

W. Welch 1 Jul. 1987 6 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987 Prepared in cooperation with Rockwell International Corp., Thousand Oaks, Calif. and Arizona State Univ., Tempe
(Contract W-7405-eng-48)
(DE87-013110; UCRL-96280; CONF-8708110-12) Avail: NTIS HC A02

Currently, the Hamamatsu and Sandia Corporations use lithium niobate (LiNbO3) in their crystal streak cameras. However, these systems have low resolution due to the low electrooptic coefficient of LiNbO3, 30 x 10 to the -12, which requires excessive voltage drives for the system. For a practical system, new tungsten bronze crystals such as barium niobate (Sr(sub 1-x)Ba/sub(x/Nb2O6) or SBN:1-x (%) for short) must be used to achieve higher resolution and lower voltage drive requirements. Electrooptic coefficients of 400 x 10 to the -12 m/V for SBN:60 and 1400 x 10 to the -12 power m/V for SBN:75 give improvements in resolution of 13 and 47, respectively. In this paper, we discuss the highlights of a light deflector developed at Lawrence Livermore National Laboratory (LLNL) for a streak camera that uses tungsten bronze crystals grown at Rockwell International Science Center. We address the design and fabrication of these crystals and include experimental results from our deflector experiment, the purpose of which is to determine the feasibility and expected performance of the crystal streak camera using tungsten bronze crystals. DOE

N88-12045# Los Alamos National Lab., N. Mex.
CINERADIOGRAPHY
J. P. Lucero and W. D. Zerwekh 1987 6 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronics Applied Sciences and Engineering, San Diego, Calif. 16 Aug. 1987
(Contract W-7405-eng-36)
(DE87-013158; LA-UR-87-2370; CONF-8708110-13) Avail: NTIS HC A02/MF A01

This paper describes a cineradiography system in use at the Los Alamos National Laboratory, as related to the advantages and disadvantages over conventional flash x-ray systems. Traditionally, x-ray imaging techniques in dynamic testing have relied on creating extremely short pulses of radiation to freeze the motion of the object, and then recording the image on film by means of fluorescent intensifying screens to obtain sufficient image density on the film. This results in images often limited only by the resolution of the film-screen combination, which are usually of reasonable quality. In a cineradiography system, two basic differences are evident. First, the radiation source emits continuously for the duration of the experiment. Second, the film is replaced by a gated, intensified television camera focused on the fluorescent screen. The image is frozen by the short gate time of the camera, rather than by the short pulse of radiation. One advantage of the television system is that the camera can be considerably distant from the screen, and if the screen is sacrificial, mechanical protection requirements are alleviated or eliminated. Another advantage is that several cameras can be focused on the same screen, allowing multiple images to be made with the same geometry. A third advantage is that the spot size of the radiation source is small, thus reducing geometrical limitations on resolution. The disadvantages of this system relate to the use of the television camera to record the image(s). Neither the resolution nor the contrast of the intensified television camera is as good as film, and this limits the quality of the image that can be produced. However, flash radiographs are often of relatively poor quality because of the limited amount of radiation available from the source and the graininess of the high-speed film required, so this is often not an important difference. DOE

N88-12046# Mound Lab., Miamisburg, Ohio.
APPLICATION OF PREDICTION OF EQUILIBRIUM TO SERVO-CONTROLLED CALORIMETRY MEASUREMENTS
R. L. Mayer, II 1987 8 p Presented at the 28th INMM Annual Meeting on Safeguards: A Mature Technology, Newport Beach, Calif., 12 Jul. 1987
(Contract DE-AC04-76DP-00053)
(DE87-013745; MLM-3448(OP); CONF-870713-58) Avail: NTIS HC A02

Research was performed to develop an endpoint prediction algorithm for use with calorimeters operating in the digital servo-controlled mode. The purpose of this work was to reduce calorimetry measurement times while maintaining the high degree of precision and low bias expected from calorimetry measurements. Data from routine operation of two calorimeters were used to test predictive models at each stage of development against time savings, precision, and robustness criteria. The results of the study indicated that calorimetry measurement times can be significantly reduced using this technique. The time savings is, however, dependent on parameters in the digital servo-control algorithm and on packaging characteristics of measured items. DOE

N88-12047# Lawrence Livermore National Lab., Calif.
CONCEPTUAL DESIGN OF A HIGH-RESOLUTION PION (0) SPECTROMETER
J. David Bowman 1987 22 p Presented at the Workshop on Proton and Neutral Meson Physics At Intermediate Energies, Los Alamos, N. Mex., 7-9 Jan. 1987
(Contract W-7405-eng-36)
(DE87-014757; LA-UR-87-2853; CONF-870158-2) Avail: NTIS HC A03/MF A01

The design of a high-resolution pion (0) spectrometer based on accurate measurements of the opening angle between the two gamma rays from pion (0) decay is discussed. The first pion (0) spectrometer of this type was built at LAMPF and first operated in 1978. It has an energy resolution of 2 MeV and solid angle of about 1 msr. During the last 10 years a considerable body of work studying the pi-nucleus and pi-nucleon charge-exchange reaction has been carried out. Many experiments being proposed and considered require a more capable instrument. During the same period there has been substantial improvement in the technologies of photon calorimetry and charged particle vertex resolution. These improvements make possible a ten-fold improvement in the energy resolution of the pion (0) spectrometer. It is also possible to achieve large improvements in solid-angle and rate capabilities. This paper reviews and develops the physical principles involved in the design of an opening angle pion(0) spectrometer. It is also shown that these principles, combined with the goals of good energy resolution, large-solid angle, and high-rate capability, constrain the design of a practical instrument. DOE

N88-12048# Lawrence Livermore National Lab., Calif.
EVALUATION SYSTEM FOR CRYSTAL STREAK CAMERAS
D. L. Steele and L. F. Jelsma 24 Aug. 1987 6 p
(Contract W-7405-eng-48)
(DE88-000238; UCID-21137) Avail: NTIS HC A02/MF A01

We have developed a system for evaluating light-steering crystals for crystal streak cameras. This report describes our system and presents a layout of the design of a streak camera for the 1- to 4- m region of the optical spectrum. DOE

N88-12049# Westinghouse Idaho Nuclear Co., Inc., Idaho Falls.
DIAGNOSTICS AID FOR MASS SPECTROMETER TROUBLE-SHOOTING
E. E. Filby, R. A. Rankin, and G. W. Webb 1987 11 p Presented at the Artificial Intelligence and Other Innovative Computer Applications in the Nuclear Industry, Sun Valley, Idaho, 31 Aug. 1987 Submitted for publication
(Contract DE-AC07-84ID-12435)
(DE88-000350; WINCO-11354; CONF-8708136-1) Avail: NTIS HC A03/MF A01

The MS Expert system provides problem diagnostics for instruments used in the Mass Spectrometry Laboratory (MSL). The most critical results generated on these mass spectrometers are the uranium concentration and isotopic content data used for process control and materials accountability at the Idaho Chemical Processing Plant. The two purposes of the system are: (1) to minimize instrument downtime and thereby provide the best

possible support to the Plant, and (2) to improve long-term data quality. This system combines the knowledge of several experts on mass spectrometry to provide a diagnostic tool, and can make these skills available on a more timely basis. It integrates code written in the Pascal language with a knowledge base entered into a commercial expert system shell. The user performs some preliminary status checks, and then selects from among several broad diagnostic categories. These initial steps provide input to the rule base. The overall analysis provides the user with a set of possible solutions to the observed problems, graded as to their probabilities. Besides the trouble-shooting benefits expected from this system, it will also provide structures diagnostic training for lab personnel. In addition, development of the system knowledge base has already produced a better understanding of instrument behavior. Two key findings are that a good user interface is necessary for full acceptance of the tool, and a development system should include standard programming capabilities as well as the expert system shell. DOE

N88-12050# AOA Apparatebau Gauting G.m.b.H. (West Germany).
ICING DETECTOR WITH EARLY WARNING CAPABILITY Final Report
Rainer Ostermayer Apr. 1985 94 p In GERMAN; ENGLISH summary
(Contract BMFT-LFL-8278/5)
(AOA-4.1.0055; ETN-87-90582) Avail: NTIS HC A05/MF A01

A method for the early warning of icing conditions was developed. The method is based on the optical anomalous dispersion of water and ice, which is used for ice detection, and a temperature decrease to enable early warning. The changing refraction behavior at a detection boundary area was examined using a radiation source and an optical branching that leads the backscattered light to a photodiode receiver. Ice on the detection area was reproducably indicated by a significant intensity change. The temperature change at the test point was measured by thermoelectric (Peltier) heat pumps. The global system produces reliable results under artificial climatic conditions as well as in long term tests in a free environment. ESA

N88-12051# European Space Agency, Paris (France).
CALIBRATION OF A FIVE HOLE PROBE AND TESTING OF AN EVALUATION METHOD FOR FLOW FIELD MEASUREMENTS
Andreas Landhaeusser May 1987 93 p Transl. into ENGLISH of Kalibrierung einer 5-Lochsonde und Erprobung eines Auswerteverfanrens zur Stroemungsfeldmessung (Goettingen, Fed. Republic of Germany, DFVLR), Feb. 1986 Original language document was announced as N87-26321
(ESA-TT-1051; DFVLR-Mitt-86-19; ETN-87-90873) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 26.50

The calibration of a five hole probe, and the testing of an evaluation method to determine the velocity vector in a three-dimensional flow field are described. The evaluation method was developed on a microcomputer for wind tunnel on-line data reduction. The practical tests of the measuring method were performed in leeward vortex flows. The results show that it is possible to determine the velocity vectors in separated vortex flows with a five hole probe and the proposed evaluation method. The computer program for the evaluation of the probe calibration is enclosed. ESA

N88-12052 British Aerospace Aircraft Group, Preston (England). Military Aircraft Div.
DEVELOPMENT OF FLOW VISUALIZATION TECHNIQUES FOR USE IN THE HOT GAS LABORATORY
J. Jackson Apr. 1987 49 p Original contains color illustrations
(BAe-ARG-233; ETN-87-90935) Copyright Avail: Issuing Activity

Shadowgraph/Schlieren methods for visualizing the shock structure in hot and cold jets; surface flow visualization on cold jets, utilizing a smooth ground board and Dayglo liquid; and combustion generated smoke for hot jet visualization were assessed. The shadowgraph and ground flow techniques give acceptable results. The smoke flow visualization is disappointing and a second test phase is required to develop the technique. ESA

N88-12053# Technische Hogeschool, Eindhoven (Netherlands). Lab. of Fluid Dynamics and Heat Transfer.
COMPARATIVE TESTING OF WIND MEASURING EQUIPMENT. PART 1: INVENTORY AND SELECTION
Hans Schotte Aug. 1986 76 p
(R-814-D-Pt-1; ETN-87-91312) Avail: NTIS HC A05/MF A01

Commercial wind measuring equipment was divided into four classes according to measuring possibilities and additional functions (e.g., data processing). Systems for testing are listed. ESA

N88-12054# National Bureau of Standards, Gaithersburg, Md. Acoustic Measurements Group.
REQUIREMENTS FOR THE CALIBRATION OF MECHANICAL SHOCK TRANSDUCERS Final Technical Note
D. C. Robinson Jun. 1987 22 p Sponsored by DOD, Redstone Arsenal, Ala.
(PB87-227591; NBS/TN-1233) Avail: NTIS HC A03/MF A01: also available SOD HC $1.25 as 003-003-02807-0 CSCL 14B

The use of obsolete, inadequate, or nonexistent calibration standards during weapons system development and acquisition make DOD and its contractors unable to validate system performance legally during testing, evaluation, and production acceptance. To correct current weakness and to meet the DOD calibration requirements of the immediate future in the area of mechanical shock new accelerometer calibration standards must be produced and existing standards must be improved. The results of a survey of various government agencies and government contractors who are actively engaged in the measurement of shock motions of 100 g or higher, are described. As part of the effort to establish current needs for the calibration of accelerometers, a study was made of the accuracy requirements in various engineering applications for the measurement of shock motions up to 200,000 g and an evaluation was made of the accuracy required to calibrate such transducers for various ranges of accelerometers. Based on the study, several recommendations are made for improving the state of calibration standards for mechanical shock accelerometers. GRA

N88-12055# National Bureau of Standards, Gaithersburg, Md. Center for Radiation Research.
NBS (NATIONAL BUREAU OF STANDARDS) MEASUREMENT SERVICES: RADIOMETRIC STANDARDS IN THE VACUUM ULTRAVIOLET Final Report
J. Z. Klose, J. M. Bridges, and W. R. Ott Jun. 1987 140 p
(PB87-227625; NBS/SP-250/3; LC-87-619833) Avail: NTIS HC A07/MF A01; also available SOD HC $6.50 as 003-003-02806-1 CSCL 07D

The radiometric calibration program carried out by the vacuum ultraviolet radiometry group in the Aromic and Plasma Radiation Division of the National Bureau of Standards is presented in detail. The calibration services are listed first, followed by descriptions of the primary standards, which are the hydrogen arc and the blackbody line arc, and the secondary standards, which are the argon mini-and maxi-arcs and the deteurium arc lamp. Next, the calibration methods involving both spectral radiance and irradiance are discussed along with their uncertainties. Finally, the intercomparison of standards as a method of quality control is described. GRA

N88-12056# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data and Information Service.
PLANNING FOR FUTURE OPERATIONAL SENSORS AND OTHER PRIORITIES
J. C. Fischer Jun. 1987 53 p

(PB87-220802; NOAA-TM-NESDIS-30) Avail: NTIS HC A04/MF A01 CSCL 14B

The plans of the Special Projects Division to define sensors that meet the user requirements are described. The need for Phase A and B instrument studies stemming from those requirements are presented. The paper is divided into four sections with each section defining and outlining areas of interest to which FY87 funds are to be committed. Section 2 defines the studies which are applicable to the polar orbiting system. Section 3 defines the studies which are applicable to the geostationary system, and Section 4 defines the studies which are applicable to both systems. The following sujects were addressed: polar orbiting system studies (global ozone monitoring radiometer, earth radiation budget instrument, polar platform scatterometer and altimeter study, advanced medium resolution imaging radiometer; geostationary system studies (advanced sounder and beyond GOES-K); system support applicable to both polar and geostationary systems (microwave sounding conferece, and microwave science support; and summary. GRA

N88-12057# Rockwell International Corp., Golden, Colo. Space Operations.
CALIBRATION STANDARD FOR METALLOGRAPHIC MICROSCOPES
M. Transue, C. A. Deitesfeld, ed., and L. M. Morales, comp. 24 Nov. 1986 9 p
(Contract DE-AC04-76DP-03533)
(RFP-3956-Rev; DOE/TIC-4500-Rev-73) Avail: NTIS HC A02/MF A01

Described is the evaluation of a diffraction grating, which can be used at magnifications of 400X or greater to establish the scale of photographs taken through a metallographic microscope. Author

N88-12058# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
MICROCOMPUTER CONTROL OF SPECTROSCOPIC INSTRUMENTS
G. S. Rossano 19 Dec. 1986 29 p
(ATR-86(8431)-4) Avail: NTIS HC A03/MF A01

A small, versatile microcomputer based data acquisition system has been developed for astronomical observing in the infrared. The hardware is a 16-bit 8086/8087 based system which has been tailored for use in spectroscopic observing programs. The hardware is operated using interactive software which permits high speed acquisition and real time analysis of spectroscopic data. The combined hardware and software system facilitates flexible, efficient and uniform operation of a variety of spectroscopic instruments. Author

N88-12059# Lawrence Livermore National Lab., Calif.
A HIGH-SPEED, EIGHT-FRAME IMAGE INTENSIFIED ELECTRO-OPTIC CAMERA WITH 200-800MM ZOOM OBJECTIVE CAPABILITY
S. A. Muelder, T. Huen, C. S. Firpo, D. F. Hein, L. L. Steinmetz, and L. L. Shaw Aug. 1987 7 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-48)
(DE88-000229; UCRL-97383; CONF-8708110-16) Avail: NTIS HC A02/MF A01

The versatility of the LLNL developed 75-mm format high-speed electro-optic camera has been improved by the addition of a microchannel plate image intensifier to the electronic image converter, and by the replacement of the discreet objective lens with a commercially available zoom lens. The image intensifier can be operated at a gain of up to 10,000. This allows the use of nanosecond or subnanosecond laser strobe light pulses for object illumination thus improving the time resolution of the camera by at least an order of magnitude. The discreet objective lens of the camera has been replaced with a fast (f/4) 200 to 400 mm zoom lens that when coupled with a quick-connect telephoto adapter (either 1.4x or 2.0x) allows the camera to operate at any focal length from 200 to 800 mm. This permits variable magnification of the object without having to move the camera and without any degradation of dynamic spatial resolution or significant loss of light gathering ability. DOE

N88-12060# Advanced Research and Applications Corp., Sunnyvale, Calif.
INSTRUMENT FOR RADIATION TESTING/SCREENING ELECTRONIC DEVICES OVER AN EXTENDED TEMPERATURE RANGE Technical Report, 15 Aug. 1985 - 30 Nov. 1986
L. J. Palkuti and M. A. Pugh 19 Dec. 1986 46 p
(Contract DNA001-85-C-0366)
(AD-A184245; ARACOR-FR-86-452; DNA-TR-86-423) Avail: NTIS HC A03/MF A01 CSCL 09A

Many military systems must be able to function over temperature ranges of -55C to 125C. Electronic devices within selected military systems must also be able to function in environments of long-term or high-intensity ionizing radiation. This program developed instrumentation and methodology that enables testing of electronic devices in such extreme conditions, using instrumentation compatible with the ARACOR Model 4100 Automatic Semiconductor Irradiation System. Instrumentation was developed to measure the integrated energy transmitted to an IC wafer die by a pulsed Nd:YAG laser beam. High and low temperature testing was found to be best achieved using a precision nitrogen gas forcing system. For Model 4100 Systems used for total-dose measurements, across the fall temperature range, a system combining a commercially-available, temperature-controlled chuck with an air stream was found to be the best solution. For low temperature, high intensity radiation testing, temperature sensors on the wafer under test were found to be required for accurate temperature control. GRA

N88-12061# Pennsylvania Univ., Philadelphia. School of Electrical Engineering.
THIN FILMS FOR GEOTHERMAL SENSING Final Report
Sep. 1987 41 p
(Contract DE-AC02-82ER-12035)
(DE88-000154; DOE/ER-12035/1) Avail: NTIS HC A03/MF A01

The report discusses progress in three components of the geothermal measurement problem: (1) developing appropriate chemically sensitive thin films; (2) discovering suitably rugged and effective encapsulation schemes; and (3) conducting high temperature, in-situ electrochemical measurements. DOE

N88-12153# Centre d'Etudes et de Recherches, Toulouse (France).
MODULATION TRANSFER FUNCTION
D. Leger *In* CNES, SPOT 1: First In-Flight Results 1987 p 79-82 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12156# Institut Geographique National, Paris (France).
EVALUATION OF SPOT STEREOSCOPIC POSSIBILITIES FOR CARTOGRAPHY
Patrice Denis, Anne-Claire deGaujac, Patrick Gigord, and Vincent Rodriguez *In* CNES, SPOT 1: First In-Flight Results 1987 p 103-108 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N88-12062# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
7 Aug. 1987 128 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-033) Avail: NTIS HC A07/MF A01

Various translated articles from Chinese books and journals are presented. All articles are generally covered under the topic of science and technology but more specifically under the topics of Aerospace, Applied Sciences, Environmental Quality, Life Sciences and Chinese National Developments. For individual titles, see N88-12063 through N88-12070.

N88-12063# Joint Publications Research Service, Arlington, Va.
POWERFUL PICOSECOND ULTRAVIOLET LASER OUTPUT AT 354.7 NANOMETERS Abstract Only
Jingyuan Dong, Qingchun Zhao, Linxing Qian, and Huijuan He *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 14 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 2, 20 Feb. 1987 p 85, 86-88 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

Frequency doubling and mixing of an active and passive mode locked YAG laser was accomplished using two types of KDP crystals. When the incident laser power density on the crystal is 1.27 GW/sq cm, stable UV laser output at 354.7 nm was realized with a pulse duration of 32 ps, peak power 30 MW, average power 60 mW and pulse repetition of 20 Hz. The layout of the laser system is shown. Other figures show triple frequency KDP crystal and its layout along the incident polarization direction, 354.7 nm sequential pulse duration, a setup to measure pulse duration, and the pulse duration recorded by a camera for BWS-5K steaks. The KDP parameters are listed in a table. Author

N88-12064# Joint Publications Research Service, Arlington, Va.
A MODE-LOCKED RUBY LASER WITH CHLOROPHYLL d AS SATURABLE ABSORBER Abstract Only
Yixian Liu and Fuming Li *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 15 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 2, 20 Feb. 1987 p 89-91, 95 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

An arrangement for a passively mode locked ruby laser with chlorophyll d as saturable absorber and the experimental results are reported. The shortest pulse duration of about 1.5 ps was measured by the TPF method. An experimental setup of the conventional passively mode locked laser is shown. Other figures show the absorption spectrum of chlorophyll d in anhydrous ethanol, pulse sequential waveform outputted by the laser, the TPF locus while chlorophyll d is used as the absorber, and the TPF measurement setup and the measured correlation function curve in the TPF photoelectric method. The relationship between theoretical pulse duration and temperature is listed as is the corresponding limiting ruby pulse duration. Author

N88-12065# Joint Publications Research Service, Arlington, Va.
MEASURING STABILITY OF OPTICAL REFERENCE CAVITIES BY ANALYZING POLARIZATION SPECTRUM Abstract Only
Zhongxing Shao and Fengming Xu *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 16 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 2, 20 Feb. 1987 p 105-108 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

A polarization method for measuring the stability of optical reference cavities is reported. Measurement with an I sub 2 stabilized He-Ne laser (stability is less than 2 x 10 to the -10th power) and sampling time of 0.01 second confirmed that the stability of a test cavity was about 1.3 x 10 to the -9th power. Some figures show the function and calculation curves, experimental curves, pulse curve, stability test result, and signal amplitude of the measured cavity mode. Author

N88-12066# Joint Publications Research Service, Arlington, Va.
SINGLE-PERIODIC MULTILAYER GRATING LASER DOPPLER VIBROMETER Abstract Only
Baocheng Wang and Jiechi Lu *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 17-18 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 2, 20 Feb. 1987 p 109-112 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

By means of a single periodic multilayer phase grating and based on the revolving field principle for velocity direction discrimination, a laser Doppler vibrometer system was developed; the system provides a potential method of velocity measurement. The theoretical analysis and experimental results of using the system are presented. A single periodic multilayer grating moving at velocity bar V is shown. Author

N88-12067# Joint Publications Research Service, Arlington, Va.
GAS DYNAMIC CHARACTERISTICS IN PAST AXIAL FLOW CO2 LASER Abstract Only
Chengwu An, Shimin Li, and Zaiguang Li *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 19 Transl. into ENGLISH from Yingyong Jiguang (Shanghi, Peoples Republic of China), v. 7, no. 2, Apr. 1987 p 54-56 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

The properties of gas flow parameters in fast axial flow CO2 lasers are studied theoretically for the purpose of proposing pneumatic measures to improve laser performance. Through numerical analysis, relationships between speed, temperature, total temperature, total pressure, static pressure, and density are derived. With increasing discharge power, the gas velocity in the discharge tube increases rapidly while its density falls quickly. Gas pressure drops off and temperature increases right up to the blower entrance. Since for a given fast axial flow laser pneumatic system it was found that the rate of temperature increase in the gas is faster than the increase in discharge injection power, improving the blower's performance in cooling the gas flow has an important positive effect, enhancing laser output. Author

N88-12068# Joint Publications Research Service, Arlington, Va.
OPERATIONAL PERFORMANCE OF REPETITIVE KrF, XeCl EXCIMER LASERS Abstract Only
Cailai Yuan, Yaokang Yue, and Baocai Jiang *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 20 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, Peoples Republic of China), v. 7, no. 2, Apr. 1987 p 76-78 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

The output characteristics of KrF, XeCl excimer laser with gas longitudinal cycling are discussed. Results show that the single pulse energy is larger than 200 mJ with a repetition rate of 10 Hz, and an average output power greater than 1W. The divergence angle is 2 x 5 mrad and with over one hour of operation at 10 Hz, the power stability is + or - 10 percent. The laser life span is 1.26 x 100,000 times. Author

N88-12069# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF TWO LASER BEAM COUPLING AND AMPLIFICATION IN Ce-DOPED SBN SINGLE CRYSTALS Abstract Only
Huaifang Xu and Xuemei He *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 21 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 4, 20 Apr. 1987 p 220-224 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

The experiment in which a laser beam was amplified by another after both beams crossed a Ce-doped (0.1 Wt percent) strontium barium niobate (Ba sub x Sr sub 1-x Nb2O6 or SBN, x = 0.48) crystal is reported and preliminary theoretical analysis is given. The density of mobile charges in Ce-SBN is calculated to be 4.5 x 10 the 16th power/cu cm (at ambient temperature). The sign of mobile charges determined from the energy flow direction is positive. Couplings at different polarizations, different wavelengths and different doping amounts are compared. Author

N88-12070# Joint Publications Research Service, Arlington, Va.
GAS FLOW EFFECTS IN PULSE AVALANCHE DISCHARGE XeCl EXCIMER LASERS Abstract Only
Jianping Qi *In its* JPRS Report: Science and Technology. China 7 Aug. 1987 p 25 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 5, 20 May 1987 p 267-271 (For primary document see N88-12062 03-36)
Avail: NTIS HC A07/MF A01

The gas velocity of a high pressure transverse flow excimer laser was measured with a laser interferometer. The effects of gas heating caused by gas discharge on the laser output power were analyzed theoretically. The maximum output power of 18 W at 16 pps was obtained with uniform transverse flow technology.
Author

N88-12071# Lawrence Livermore National Lab., Calif.
HIGH AVERAGE POWER SOLID STATE LASER POWER CONDITIONING SYSTEM
R. F. Steinkraus 3 Mar. 1987 6 p Presented at the 6th Institute of Electrical and Electronics Engineers Pulsed Power Conference, Baltimore, Md., 29 Jun. 1987
(Contract W-7405-eng-48)
(DE87-013558; UCRL-96239; CONF-8706204-1) Avail: NTIS HC A02/MF A01

The power conditioning system for the High Average Power Laser program at Lawrence Livermore National Laboratory (LLNL) is described. The system has been operational for two years. It is high voltage, high power, fault protected, and solid state. The power conditioning system drives flashlamps that pump solid state lasers. Flashlamps are driven by silicon control rectifier (SCR) switched, resonant charged, (LC) discharge pulse forming networks (PFNs). The system uses fiber optics for control and diagnostics. Energy and thermal diagnostics are monitored by computers.
DOE

N88-12072# Rochester Univ., N. Y. Lab. for Laser Energetics.
LLE (LABORATORY FOR LASER ENERGETICS) REVIEW, VOLUME 31 Quarterly Report, Apr. - Jun. 1987
W. Donaldson, ed. 1987 60 p
(Contract DE-FC08-85DP-40200)
(DE87-013732; DOE/DP-40200/47-Vol-31) Avail: NTIS HC A04/MF A01

This volume of the LLE Review, covering the period April-June 1987, contains a summary of the recent high-density campaign on the OMEGA laser system; a report on the absorption and radiation of energy from spherically irradiated targets; and a computer model describing the source of hot spots in the OMEGA laser. The section on advanced technology has reports on a method for accurately measuring the phase of a high-power laser and the development of an extremely bright and compact laser. Finally the activities of the National Laser Users Facility and the GDL and OMEGA laser facilities are summarized. The highlights of this issue are: the high-density campaign using gas-filled targets on the OMEGA laser system resulted in fuel compressions of 50 times liquid DT density; measurements on spherically irradiated targets have demonstrated that the one-dimensional hydrodynamic code LILAC can accurately predict the absorption of ultraviolet radiation and the subsequent production of x rays; the source of hot spots in the target-plane intensity profile of the OMEGA ultraviolet beams has been identified.
DOE

N88-12073# Los Alamos National Lab., N. Mex.
ANALYSIS OF UNDULATOR FIELD ERRORS FOR XUV FELs (EXTREME ULTRAVIOLET FREE ELECTRON LASER)
C. James Elliott and Brian D. McVey 1987 26 p Presented at the Conference on Undulator Magnets for Synchrotron Radiation and Free Electron Lasers, Trieste, Italy, 23 Jun. 1987
(Contract W-7405-eng-36)
(DE87-014734; LA-UR-87-2653; CONF-8706192-1) Avail: NTIS HC A03/MF A01

A number of magnetic field errors for extreme ultraviolet free electron lasers is discussed. Longitudinal coherence phase is one important parameter. For long undulators, beam wander is the important criterion; for segmented undulators with short segments, longitudinal coherence is the important criterion. An effective way to control field errors is shown to be segmentation of the undulator. Sample calculations are given.
DOE

N88-12074# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheski Inst.
PRODUCTION OF ATOM FLOWS AT MATERIALS EVAPORATION BY LASER RADIATION
Ya. F. Volkov, V. G. Dyatlov, G. V. Zelenin, V. D. Kotsubanov, N. I. Mitina, I. K. Nikolskij, and G. P. Pavlova 1986 8 p
In RUSSIAN
(DE87-703327; KFTI-86-12) Avail: NTIS (US Sales Only) HC A02/MF A01

Parameters of atom fluxes obtained by laser evaporation from the surface of a massive target are studied. The target consists of Al and Ag. Total quantity of substance removed from the surface of the target at the expense of laser radiation is measured by weighing. Energy distribution and quantity of evaporated atoms are determined by resonance radiation absorption. Duration of evaporation is identified by measured time characteristics of thermal radiation of the target surface. The head part of the flux comprising plasma is investigated by double probe and RF-signal absorption (lambda = 3 cm). Optimum energy density of an evaporating pulse is shown to equal 3-4 J/sq cm when using monopulse ruby laser of 3.5 J beam energy and duration of 30 ns. Quantity of evaporated substance in the flux at this energy density makes up 4x10 to the 16th and 2x10 to the 17th power at. per pulse for Al and Ag respectively. At optimum energy density drops and plasma make up not more than 20% of the vapor mass. Here the energy of vapor atoms in the flux is equal to 2 eV and the head part of the flux moves at the velocity corresponding to an energy of 130 eV. These requirements comply with requirements to the flux for simulation of natural inflow of impurities into plasma at the expense of sputtering and arc-formation.
DOE

N88-12075# Technische Hochschule, Darmstadt (West Germany). Fachbereich Physik.
DIFFRACTION EFFECTS DURING MATERIALS TREATMENT WITH LASER BEAMS Ph.D. Thesis [BEUGUNGSEFFEKTE BEI MATERIALBEARBEITUNG MIT LASERSTRAHLEN]
Yash P. Kathuria 1985 136 p In GERMAN
(ETN-87-90614) Avail: Issuing Activity

A method for the fast calculation of three-dimensional diffraction patterns of different kinds of diaphragms was developed for a high power laser system and laser-matter interaction problems. The method, based on the Hopkins algorithm, computes the Fresnel diffraction at elliptical diaphragms. It is shown that the intensity maxima move towards the focal points with decreasing axis ratio. The calculation of the diffraction field at focussed annular diaphragms is discussed. Previous results were used for the calculation of the focal shift and the position of the intensity maximum on the optical axis. Theoretical predictions were experimentally verified using an He-Ne laser and a pulsed Nd-YAG laser.
ESA

N88-12076# European Space Agency, Paris (France).
METHODS FOR A COHERENT CO2 LASER HETERODYNE RADAR SYSTEM
Eugen Biselli Sep. 1987 41 p Transl. into ENGLISH of Methoden fuer ein Kohaerentes CO2-Laser-Heterodyn-Radar (Oberpfaffenhofen, Federal Republic of Germany) Original language document was previously announced as N87-18089
(ESA-TT-1035; DFVLR-FB-86-33; ETN-87-91114) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 15

Procedures to eliminate the ambiguity of the direction for laser Doppler velocimetry are analyzed. The intrinsic methods show the best results at comparatively low expense: the theoretical signal-to-noise ratio is realized in practice.
ESA

N88-12077# European Space Agency, Paris (France).
INVESTIGATION OF THE FABRICATION PARAMETERS OF LASER MIRRORS WITH HARD OXIDE INTERFERENCE COATINGS
Dirk-Roger Schmitt, Rolf Gauert, and Helmut Rosteck Sep. 1987 41 p Transl. into ENGLISH of Untersuchung der Herstellungsparameter von Laserspiegeln aus Harten Oxidischen Interferenzschichten (Brunswick, Fe. Republic of Germany, DFVLR), Aug. 1986 Original language document was announced as N87-26333
(ESA-TT-1064; DFVLR-FB-86-56; ETN-87-91128) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of GErmany DM 16

Hard oxidic interference coatings of TiO2/SiO2, some with an Ag coating, were fabricated for laser mirrors for laser gyroscopes. The laser mirrors were fabricated for an incidence angle of 30 deg, and a wavelength of 633 nm. The dependence of reflectivity and scattering on the evaporation parameters was determined. It is found that oxygen partial pressure and cathode sputter voltage strongly influence oxidation, especially of the TiO2 coatings. Reflectivities as high as 0.9994 are achieved. ESA

N88-12078 California Inst. of Tech., Pasadena.
HIGH POWER PHASED ARRAY AND TAILORED GAIN SEMICONDUCTOR LASERS Ph.D. Thesis
Christopher Paul Lindsey 1987 247 p
Avail: Univ. Microfilms Order No. DA8710945

The problem of phase locked semiconductor laser arrays suffering from undesirable twin lobed farfield patterns is studied and solved. A tailored gain chirped array which emits 450 mW into a single beam 3.5 deg wide is demonstrated. Stripe geometry lasers for use in phased arrays are examined, as are design considerations for evanescently coupled phased arrays. A numerical method for analyzing a nearly arbitrary one-dimensional dielectric waveguide with gain and/or loss is described. An array of two adjacent waveguides, both real index and gain guided and both weakly and strongly coupled, is analyzed. A combination of gain tailoring and a high interchannel gain in a proton implanted chirped array allows the fabrication of a high power array with a single lobed farfield pattern. Another method for gain tailoring is the halftone process, which can create nearly arbitrary two-dimensional spatial gain profiles in an optoelectronic device. Single lobed nearly diffraction limited beams from tailored gain broad area lasers 50 micrometers wide are obtained. A technique of Path Analysis for anlyzing complex tailored gain waveguides is introduced. Fundamental Fourier Transform relationships relating device structure to farfield patterns yield additional insights. A measurement of the antiguiding parameter and an examination of design criteria for practical tailored gain broad area lasers are included. Dissert. Abstr.

N88-12079 Brown Univ., Providence, R. I.
DISTRIBUTED FEEDBACK EFFECTS IN LASERS AND HIGH GAIN LASER INSTABILITIES IN OPTICALLY PUMPED CH3F Ph.D. Thesis
William S. Rabinovich 1987 186 p
Avail: Univ. Microfilms Order No. DA8715549

The effects of finite Bragg gratings in lasers are studied. The threshold mode structure of distributed feedback (DFB) media in partially filled ring cavities is found. When the mode spacing of the unfilled ring cavity and the distributed feedback structure are not the same, the feedback from the ring cavity can increase the mode selectivity of the DFB laser. The mode structure and dynamics of homogeneously broadened bidirectional lasers are studied. These lasers may induce their own Bragg gratings in the susceptibility through standing wave saturation of the gain medium. The structure of the laser modes when this occurs is studied using the ring-DFB theory, and a Fourier decomposed rate equation model is developed to study the dynamic behavior of these modes above threshold. The model is used to explain experimental results that show large bichromatic splittings in a Rhodamine 6G dye laser and is also applied to the cw pumped ruby laser where it predicts regimes in which regular undamped and irregular damped pulsing can occur. Secondly, the irregular spiking of the output of a far infrared (FIR) CH3F laser pumped by a temporally smooth CO2 TEA laser pulse is studied. The FIR laser can lase simultaneously by inversion at 496 micrometers and by depletion at 452 micrometers. The FIR laser is first characterized so as to determine appropriate approximations for the model of the system. A semiclassical theory for the two coupled lasing transitions is developed which include the complicated kinetics of the system. Theoretical output pulses found by numerically integrating the coupled transition equations are compared to experimental pulses. Both the experimental and theoretical pulse form show extreme sensitivity to small changes in the system parameters. This sensitivity is shown to arise from the coupling of the two laser transitions. Dissert. Abstr.

N88-12080# Naval Postgraduate School, Monterey, Calif.
A THEORETICAL STUDY OF ENHANCED SMITH-PURCELL RADIATION FROM A BIGRATING Final Report
Nathaniel E. Glass 15 Jun. 1987 7 p
(Contract MIPR-ARO-150-860)
(AD-A184530; ARO-23995.2-PH) Avail: NTIS HC A02/MF A01 CSCL 09C

A theory has been developed of the Smith-Purcell diffraction radiation from a beam of point charges passing over a finitely conducting bigrating surface, with arbitrary orientation of the beam relative to the bigrating axes. The beam's field can resonantly excite one or more surface-plasmon polaritons, which the bigrating can then decouple into a single outward radiating wave at any given angle and frequency. This process enhances the radiated power by two or three orders of magnitude in the peak direction. Numerical implementation of the theory has shown that there is an optimal grating height at which this surface-plasma enhanced radiation peak is at a maximum. This work has also shown that a sinusoidal bigrating, forming a rectangular lattice, can yield an added enhancement, through two-plasmon excitation, when compared to the radiation from a classical grating (periodic in one direction). GRA

N88-12081# Hughes Research Labs., Malibu, Calif.
EXCIMER LASER-ASSISTED DEPOSITION OF GaAs, AlAs AND (Al,Ga)As FROM LEWIS ACID-BASE ADDUCTS Interim Technical Report No. 1, Oct. 1986 - Aug. 1987
J. J. Zinck, P. D. Brewer, J. E. Jensen, G. L. Olson, and L. W. Tutt 12 Aug. 1987 10 p Submitted for publication
(Contract N00014-81-C-0642)
(AD-A184588) Avail: NTIS HC A02/MF A01 CSCL 20L

Laser-assisted deposition of GaAs, AlAs and (Al,Ga)As thin films on Ge 100 substrates from trimethylgallium-trimethylarsenic and trimethylaluminum-trimethylarsenic Lewis acid-base adduct source materials is reported. A parametric study has been performed in which reactive gas pressure, substrate temperature, laser fluence, laser wavelength (248 nm or 193 nm), and orientation of the laser beam with respect to the substrate have been varied. In the case of irradiation parallel to the substrate, stoichiometric films of GaAs and (Al,Ga)As have been obtained. The data suggest that for irradiation perpendicular to the substrate a competition exists between desorption and photodeposition, which adversely affects film stoichiometry under the conditions studied. GRA

N88-12082# Lawrence Livermore National Lab., Calif.
ULTRAFAST PHOTOCONDUCTOR DETECTOR-LASER-DIODE TRANSMITTER
C. L. Wang, B. A. Davis, T. J. Davies, M. A. Nelson, M. C. Thomas, and P. A. Zagarino (Edgerton, Germeshausen and Grier, Inc., Goleta, Calif.) 1987 4 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987 Prepared in cooperation with EG and G, Inc., Las Vegas, NV.;EG and G, Inc., Goleta, CA.
(Contract W-7405-eng-48)
(DE87-013803; UCRL-96005; CONF-8708110-15) Avail: NTIS HC A02

The results of an experiment is reported in which an ultrafast, photoconductive, radiation detector is used to drive a fast laser-diode transmitter. When the neutron-damaged Cr-doped GaAs detector was irradiated with 17-MeV electron beams, the temporal response was measured to be less than 30 ps. The pulses from this detector modulated a fast GaAlAs laser diode to transmit the laser output through 30- and 1100-m optical fibers. Preliminary results indicate that 50- and 80-ps time resolutions, respectively, are obtainable with these fibers. Work is now being done to integrate the photoconductive detector and the laser diode transmitter into a single chip. DOE

N88-12083# Lawrence Livermore National Lab., Calif.
LASER SOURCES TODAY AND TOMORROW
M. J. Weber 22 Jul. 1987 10 p Presented at the 1st International Conference on Laser M 2 P, Lyon, France, 7 Jul. 1987
(Contract W-7405-eng-48)
(DE87-014247; UCRL-96859; CONF-8707107-1) Avail: NTIS HC A02/MF A01

Properties of current gas, liquid and solid-state laser sources are surveyed briefly, including the prospects for their further development. Of particular interest are recent advances in semiconductor diode and tunable solid-state lasers and the expanding experimental activities in x-ray lasers and free electron lasers. Improved electron beams and periodic magnetic structures (wigglers, undulators) are technologies that free electron lasers share with advanced synchrotron radiation sources. The tunable, high brightness, partially coherent radiation from the latter will also be useful for many applications. DOE

N88-12084# Lawrence Livermore National Lab., Calif.
A MICROWAVE FEL (FREE ELECTRON LASER) CODE USING WAVEGUIDE MODES
J. A. Byers and R. H. Cohen Aug. 1987 12 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract W-7405-eng-48)
(DE88-000225; UCRL-97348; CONF-8709110-3) Avail: NTIS HC A03/MF A01

A free electron laser code, GFEL, is being developed for application to the LLNL tokamak current drive experiment, MTX. This single frequency code solves for the slowly varying complex field amplitude using the usual wiggler-averaged equations of existing codes, in particular FRED, except that it describes the fields by a 2D expansion in the rectangular waveguide modes, using coupling coefficients similar to those developed by Wurtele, which include effects of spatial variations in the fields seen by the wiggler motion of the particles. Our coefficients differ from those of Wurtele in two respects. First, we have found a missing sq root of 2 gamma/a sub w factor in his C sub z; when corrected this increases the effect of the E sub z field component and this in turn reduces the amplitude of the TM mode. Second, we have consistently retained all terms of second order in the wiggle amplitude. Both corrections are necessary for accurate computation. GFEL has the capability of following the TE sub 0n and TE(M) sub m1 modes simultaneously. GFEL produces results nearly identical to those from FRED if the coupling coefficients are adjusted to equal those implied by the algorithm in FRED. Normally, the two codes produce results that are similar but different in detail due to the different treatment of modes higher than TE sub 01. DOE

N88-12085# Pennsylvania State Univ., University Park. Dept. of Physics.
STUDY OF FIELD ADSORPTION USING PULSED-LASER FIELD ION MICROSCOPY Final Technical Report
T. T. Tsong 22 May 1987 5 p
(Contract DE-AC02-81ER-10857)
(DE88-000310; DOE/ER-10857/T3) Avail: NTIS HC A02/MF A01

This report briefly describes development and resolution of two time-of-flight spectrometers. Also discussed is research carried out on gas molecule adsorption on metal surfaces. DOE

N88-12086# Naval Postgraduate School, Monterey, Calif.
OPTICAL LASER TECHNOLOGY, SPECIFICALLY CD-ROM (COMPACT DISC - READ ONLY MEMORY) AND ITS APPLICATION TO THE STORAGE AND RETRIEVAL OF INFORMATION M.S. Thesis
David J. Lind Jun. 1987 132 p
(AD-A184111) Avail: NTIS HC A07/MF A01 CSCL 09E

One of the significant problems of this information age is the production of vast amounts of information in a form that is neither convenient nor cost effective. A possible solution to this, is the new optical laser technology and its use in the storage and retrieval of large amounts of information. In many areas of DOD, the greatest benefit would be the regained space and weight associated with the distribution of the manuals and other typically paper products on a Compact Disc - Read Only Memory (CD-ROM). One CD-ROM weighs less than an ounce and is capable of storing over 270,000 pages of text. The saved shipping and handling costs alone would be astronomically reduced not to mention the end user who would have a more effective and efficient product. The CD-ROM is designed to work as a peripheral device to a microcomputer and can therefore be made available to any user within an IBM compatible microcomputer. The application/demonstration portion of this thesis took over 2 million database records, from the Transaction Ledger on Disc (TLOD), at the Naval Supply Center (NSC) in Oakland and pressed them to a single CD-ROM. The menu driven retrieval software with indexing on 3 criteria was also provided. GRA

N88-11876# Joint Publications Research Service, Arlington, Va.
EFFECTS OF INJECTION OF FREE ELECTRON LASERS ON AXIAL VELOCITY SPREAD OF BEAMS
Yuandian Wang *In its* China report: Science and Technology 9 Apr. 1987 p 55-62 Transl. into ENGLISH from Zhongguo Jiguang (Shanghi, Peoples Republic of China), v. 13, no. 11, 20 Nov. 1986 p 671-674, 682 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

N88-11879# Joint Publications Research Service, Arlington, Va.
XeCl EXCIMER LASER WITH MAGNETIC COMPRESSOR
Qihong Lou, Jianping Qi, Runwen Wang, Yunrong Wei, Aizhen Ding, Jingxing Dong, Zean Ding, and Guoqing Wu *In its* China report: Science and Technology 9 Apr. 1987 p 63-69 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 13, no. 11, 20 Nov. 1986 p 683-686 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

N88-11883# Joint Publications Research Service, Arlington, Va.
XeCl EXCIMER LASER INDUCED MULTIPROTON IONIZATION OF AMMONIA MOLECULE Abstract Only
Jingcheng Han and Rong Zhu *In its* JPRS report: Science and Technology. China 14 Jul. 1987 p 16-17 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 3, Mar. 1987 p 216-222 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

N88-11889# Joint Publications Research Service, Arlington, Va.
TWO-LASER RESONANCE ENHANCED PHOTOIONIZATION SPECTRUM OF GAS PHASE BENZENE Abstract Only
Junying Fan, G. Muller, W. E. Schmid, K. L. Kompa, and J. L. Lyman *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 1-2 Transl. into ENGLISH of Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 1, Jan. 1987 p 1-10 Prepared in cooperation with Max-Planck Inst. for Quantum Optics, Munich, Federal Republic of Germany (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

N88-11890# Joint Publications Research Service, Arlington, Va.
INTRACAVITY ABSORPTION SPECTROSCOPY WITH RING TRAVELING-WAVE DYE LASER Abstract Only
Huayong Yong *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 5 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 1, Jan. 1987 p 11-16 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

N88-11891# Joint Publications Research Service, Arlington, Va.
STUDY OF IR LASER PHOTOACOUSTIC SPECTRA OF ORGANIC MOLECULES ADSORBED ON METAL SURFACE
Huizong Lu, Kaitai Chen, and Zhaoyong Wang *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 7-13 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6, no. 12, Dec. 1986 p 1057-1062 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

N88-11893# Joint Publications Research Service, Arlington, Va.
ULTRA-SHORT PULSE LASER SYSTEM USED FOR LAGEOS RANGE FINDING
Huijuan He, Yongchun Li, Shengru Gu, Linxing Qian, Longxing Zhao, Detong Tan, Chikun Xiao, Wanzhen Cheng, and Fumin Yang *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 25-31 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6 no. 12, Dec. 1986 p 1092-1097 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

N88-11901# Joint Publications Research Service, Arlington, Va.
A 10 W TRANSVERSE FLOW EXCIMER LASER
Qihong Lou, Chengen Zheng, Miao Jiang, Yueqing Jiang, Zean Ding, Aizhen Ding, Jingxing Dong, Yunrong Wei, Jianping Qi, and Runwen Wang *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 29-36 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 13, no. 10, 20 Oct. 1986 p 635-638; 645 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-11902# Joint Publications Research Service, Arlington, Va.
SATURABLE ABSORBERS FOR COLLIDING PULSE-LOCKED Nd:YAG LASERS
Xing Lin, Wenzhen Zhang, Fengtie Wu, Huiming Zhuang, Yunshan Zheng, and Zhanao Sun *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 37-40 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 13, no. 10, 20 Oct. 1986 p 664-665 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-11903# Joint Publications Research Service, Arlington, Va.
EXCIMER LASER CELL WITH LONGITUDINAL ELECTRON-BEAM EXCITATION
Zhenhua Guo, F. K. Tittle, and J. Liegel *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 41-49 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 245-249 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-11904# Joint Publications Research Service, Arlington, Va.
PHYSICAL DESIGN OF PARAMETERS OF Nd:YAG DISK LASER
Meizhen Zhang, Weilou Cao, Qinghao Chen, and Fulin Tang *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 50-55 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 256-258 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-11905# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF BN CO2 WAVE GUIDE LASER
Fuquan Zhang, Zhonghua Zhang, Fengmei Liu, Yusan Wang, Taixun Zhu, and Jingshan Zhao *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 56-61 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 262-264 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-11906# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL STUDY OF STABILIZING He-Ne LASER OUTPUT POWER WITH TRANSVERSE MAGNETIC FIELD
Shunchao Xu and Guojung Lei *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 62-65 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 6, no. 6, Dec. 1986 p 274; 275-276 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

N88-11907# Joint Publications Research Service, Arlington, Va.
STATUS, DEVELOPMENT OF LASER DEVICES IN CHINA
Xinneng Wo *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 66-75 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 7, no. 2, Apr. 1987 p 49-53 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-12087# Adiabatics, Inc., Columbus, Ind.
ADVANCED NATURAL GAS FUELED ENGINE DEVELOPMENT. PART 1: DESIGN AND ANALYSES Final Report, Apr. 1985 - Jul. 1986
R. Kamo, R. Walson, R. M. Kakwani, and L. Kamo Nov. 1986 94 p
(Contract GRI-5084-233-1048)
(PB87-224804; FR8415-1186-Pt-1; GRI-86/0205.1) Avail: NTIS HC A05/MF A01 CSCL 13I

The objective of the research program was to design an advanced natural gas engine (NG 1990) to be produced in the 1990s which will have high thermal efficiency and 40,000 hours durability of the valve train components before major engine overhaul. Preliminary design and feasibility of the NG 1990 advanced natural gas engine was completed. A natural gas engine simulation model predicts up to 43.6 percent brake thermal efficiency (5840 Btu/hp-hr BSFC) for the advanced engine with the advanced concepts like K-Miller cycle (early intake valve closing), lean burn combustion - A/F ratio = 24.5, high compression ratio up to 14:1, higher turbocharger efficiency of 63.2 percent overall, and axially stratified charge combustion system resulting in fast burning. The use of K-Miller cycle reduces the in-cylinder gas temperatures and allow engine operation at 14:1 compression ratio without knock tendencies. The design and analyses of the NG1990 engine and its components like K-Miller system were completed in the program. GRA

N88-12088# Adiabatics, Inc., Columbus, Ind.
ADVANCED NATURAL GAS FUELED ENGINE DEVELOPMENT. PART 2: MATERIALS INVESTIGATION Final Report, Apr. 1985 - Jul. 1986
R. Kamo, R. Walson, and L. Kamo Nov. 1986 136 p
(Contract GRI-5084-233-1048)
(PB87-223160; FR8415-1186-Pt-2; GRI-86/0205.2) Avail: NTIS HC A07/MF A01 CSCL 13I

The program was undertaken in an effort to identify advanced materials and coatings capable of increasing the reliability and durability of valve train components in an industrial sized, natural

gas refueled, reciprocating prime mover. Excessive valve train wear was identified as the primary cause of frequent maintenance requirements for gas fueled reciprocating prime movers. Promising material and coating candidates were subjected to laboratory friction wear testing, single cylinder engine rig testing, and full scale engine dynamometer testing on a Cummins GTA 855 for 300 hours. Metallics, CerMets, and monolithic and composite ceramics were selected for evaluation. A cursory evaluation of low friction piston ring and cylinder wall materials was also conducted. The results of this program suggest promise for the use of advanced materials as a means of improving the reliability and durability of the valve train of natural gas fueled reciprocating prime movers. Additional testing is required to generate more statistically significant data, and to establish greater confidence in the predictive capability of the test methods employed. GRA

N88-12089# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
BEARING LOADS IN SLIDER CRANK MECHANISMS Final Report
K. H. Means and G. A. Cummings Jun. 1987 159 p
(Grant NSF MEA-83-11601)
(PB87-216495; NSF/ENG-87008) Avail: NTIS HC A08/MF A01 CSCL 13K

The slider-crank mechanism is used in many applications including internal combustion engines, punch presses, and many applications requiring reciprocating motion. The bearing reactions in a slider-crank mechanism are measured and the results compared to a rigid body model. The method of analysis includes designing a mechanism using a rigid-body model that predicts the expected loads on the mechanism. The parameters will be estimates of the final mechanism parameters. To measure the bearing reactions, the crank and slider will be suspended on load transducers. The mechanism and support will then be built. Next the bearing reactions will be measured with the aid of a computer based data acquisition system. Then the actual mechanism will be modeled using the same procedure as the initial estimates. The results of the measured and the final model will be compared. GRA

N88-12090# Sandia National Labs., Albuquerque, N. Mex.
MODELS FOR PENETRATION OF THIN PLATES
S. L. Passman 1987 5 p Presented at the 5th Topical Conference of the American Physical Society on Shockwaves in Condensed Matter, Monterey, Calif., 20 Jul. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013727; SAND-87-0727C; CONF-870753-74) Avail: NTIS HC A02

A model is developed for breakup of a cylindrically symmetric body which has impacted normally on a thin plate, where the speed of impact is very high. This model exhibits different qualitative breakup phenomena than those for lower speeds of impact. Comparison of the model with results computed with the two-dimensional wavecode CSQ shows good agreement. DOE

N88-12091# Science Applications International Corp., San Diego, Calif.
NUMERICAL SIMULATION OF INTERNAL COMBUSTION ENGINE FLOWS: DEVELOPMENT AND USERS GUIDE FOR MAGIC RADIAL-AZIMUTHAL VERSION
C. C. Hsiao, F. Y. Su, and R. M. Traci Apr. 1987 45 p
(Contract DE-AC04-79ET-15397)
(DE87-014453; DOE/ET-15397/T6-Vol-1) Avail: NTIS HC A03/MF A01

Although the physical modelling approaches presented are based on the well-established methods used in MAGIC, it was decided to implement a more current and potentially flexible set of numerical model approaches in MAGIC-RT. Thus, the computer code described in this report is entirely new and as a result required its own testing and validation studies that have occupied the bulk of the effort to date. As a result, the present report is divided into two main technical sections: Section 2, which described the methods and models utilized in MAGIC-RT, and Section 3, which summarizes the test case calculations performed to date. Finally, Section 4 provides a preliminary User's Guide for MAGIC-RT, which could permit an experienced numerical analyst to use the program. DOE

N88-12092# Kernforschungszentrum, Karlsruhe (West Germany).
COMPONENTS FOR MEASURING ROBOTS
O. Klingler, S. Gruhler, K. Linder, B. Mossmann, and E. Wagner Oct. 1986 43 p In GERMAN; ENGLISH summary
(Contract BMFT-FT-1000-3)
(KfK-PFT-126; ETN-87-90585) Avail: NTIS HC A03/MF A01

A measuring robot for the manufacturing industry which controls the quality during the manufacturing process and indicates tolerances for automatic correction for machining was developed. Special care was taken in the design and manufacture of the robot components to ensure automatic interchangeability without manual intervention. The measuring robot components, such as articulated and swivel joint, 3D probes, probe changers and the appropriate controls were designed, manufactured, and tested using a 3D measuring system. ESA

N88-12093# BAJ Vickers Ltd., Banwell Weston-super-Mare (England).
THE MECHANICAL PROPERTIES OF SOLID STATE DIFFUSION BONDS BETWEEN TI-6AI-4V AND 304L STAINLESS STEEL
P. S. Moore 26 Jan. 1987 28 p
(Contract RAE-A91B/1616)
(BAJ-TR-113-1987; BR101935; ETN-87-90934) Avail: NTIS HC A03/MF A01

Diffusion bonding of Ti alloy to stainless steel, as in satellite attitude control system pipes and valves, was tested. Results reveal a tendency to form intermetallic compounds at the bond interface, which results in relatively low strength joints. The intermetallic formation is avoided by the interposition of metal foils to act as diffusion barriers and significant improvements in tensile strength are achieved. Joints produced with vanadium + copper interlayers have tensile strengths of 399 to 470 MPa and joints with vanadium + copper + nickel interlayers have tensile strengths of 297 to 404 MPa; the impact strength of both interlayer combinations is low. The impact specimens generally have a ductile fracture appearance and the low impact values are thought to be caused by a plastic constraint effect rather than the presence of intermetallic compounds or diffusion bonding defects. ESA

N88-12094# Westland Helicopters Ltd., Yeovil (England).
WEAR OF HARD STEEL IN ROLLING LUBRICATED CONTACT Ph.D. Thesis Final Report
A. V. Olver May 1986 264 p
(Contract MOD(PE)-2037/0247-XR/MAT)
(RP-699; BR99827; ETN-87-90938) Avail: NTIS HC A12/MF A01

Experiments on case hardened steel showed that quite severe wear is repeatably obtained under moderate contact pressures and very low amounts of sliding when the specific film thickness was low. It is shown that residual tension is present in a direction perpendicular to the observed fatigue cracks and having a similar relationship to the surface tractive forces. The effects of hardness, slide/roll ratio, load, and oil temperature were tested. Results show a marked dependence of wear rate on hardness difference between the contacting surfaces, in a manner consistent with the need for plastic asperity deformation. Wear depends strongly on load but is little affected by changes in sliding velocity. It is concluded that the wear mechanism consists of cyclic plastic asperity deformation; initiation of numerous, shallow fatigue cracks; and extrusion and separation of material near the crack mouths. ESA

N88-12095 Wayne State Univ., Detroit, Mich.
ON THE CONTROL OF A COMPLIANT ROBOT ARM Ph.D. Thesis
Mariana Gabriela Forrest-Barlach 1987 220 p
Avail: Univ. Microfilms Order No. DA8714538

The problem of end-point position control of a flexible robot arm undergoing fast motion is addressed. It is assumed that, by design, either the drive train compliance or the structural flexibility will predominate. The problem is approached from two different perspectives. In the first case, the joint flexibility is considered predominant, and the joints are assumed stiff. The effect of compliance parameter variation on the controller performance was evaluated. A robust PI design for the interdependent joint control (IJC) structure was presented. For the second case, the same arm configuration is considered, for which the radial degree of freedom (DOF) is locked. A modal control law for the structurally flexible arm was developed. Closed loop responses of the control of structures for both cases were evaluated through simulation utilizing the Advanced Continuous Simulation Language (ACSL). The inverse dynamics controller was implemented in real-time on a multiprocessor system. The results indicated that a multiprocessor system is needed for the control of flexible robot arms.
Dissert. Abstr.

N88-12096 Drexel Univ., Philadelphia, Pa.
DYNAMICS AND STABILITY OF BIPEDAL LOCOMOTION ROBOTS Ph.D. Thesis
Yildirim Hurmuzlu 1987 137 p
Avail: Univ. Microfilms Order No. DA8716197

The dynamics and stability of a certain class of bipedal locomotion systems is analyzed. The objective is to study the issues of stability and progression of bipedal locomotion systems and to explore the mechanisms that produce these actions. The proposed ideas and principles are verified by developing mathematical models of four systems, which range from a very simple two-dimensional, two-element system to a three-dimensional four-element system. The time response of these models, subject to various initial conditions and disturbances is obtained by computer simulation techniques. The stability is studied by utilizing phase plane portrait and Poincare Maps of the generalized coordinates. Impact of the limbs with the ground and switching of the body weight from one limb to the other plays a very important role in the stability of the models considered. The models are proved to be asymptotically stable under a wide range of position and velocity perturbations. Furthermore, the structural stability analysis which was carried out by using Poincare Maps proved that the three-dimensional four-element system is stable for certain intervals of the structural parameters. Dissert. Abstr.

N88-12097 Florida Univ., Gainesville.
A THEORY FOR THE ARTICULATION OF ROBOT MANIPULATORS Ph.D. Thesis
Li Young 1986 135 p
Avail: Univ. Microfilms Order No. DA8716070

The degree of flexure of a single robot at any instant is quantified properly by determining upper and lower bounds and hence the permissible ranges of the orientations of each of the links. The degree of flexure of the robot is related to the first by determining the relative locations (positions and orientations) of pairs of links in each of the two chains. The process yields a mapping space for measuring the relative location of pairs of links. This mapping is simplified by introducing an affine transformation which leaves an invariant manifold determining the inference. Finally, the degrees of flexure of the multiple manipulators are obtained by determining the relative locations being outside the invariant manifolds mentioned before in the mapping spaces for pairs of links.
Dissert. Abstr.

N88-12098# Rockwell International Corp., Golden, Colo. Space Operations.
DIFFUSION BONDING DEPLETED URANIUM TO COPPER
C. M. Edstrom, R. L. Thomas, ed., and I. C. Delaney, comp. 11 Nov. 1986 28 p
(Contract DE-AC04-76DP-03533)
(RFP-3783-Rev; DOE/TIC-4500-Rev-73) Avail: NTIS HC A03/MF A01

Copper can be diffusion bonded to depleted uranium (D38). The use of an interlayer, such as nickel, reduces the temperature required for the diffusion bond. The diffusion bonding can be accomplished with either a vacuum hot press or hot isostatic press producing bonded products with the strength to withstand the forces of upset forging and rolling. The deformation of forging and rolling actually increases the shear strength of the bond. Author

N88-12099# Rockwell International Corp., Golden, Colo. Space Operations.
TAPER SECTIONING TO MAGNIFY THE INTERFACE THICKNESS OF A DISSIMILAR METAL JOINT
S. Tsang, P. A. Kneale, J. B. Steacy, R. L. Thomas, ed., and I. C. Delaney, comp. 8 Aug. 1986 31 p
(Contract DE-AC04-76DP-03533)
(RFP-3890-Rev; DOE/TIC-4500-Rev-73) Avail: NTIS HC A03/MF A01

Taper sectioning produces additional magnification across the interface of a dissimilar metal joint. It is possible to examine a very thin diffusion layer, which sometimes is hardly discernible by conventional longitudinal sectioning. This techniques was applied to examine the interface of solid-state bonds and friction welds of aluminum (or its alloy) and Type 316 stainless steel. Methods are described for preparing taper sectioning mounts and examining the diffusion layer by various means. Author

N88-12100# Sandia National Labs., Albuquerque, N. Mex.
EVALUATION OF VISION SYSTEMS FOR TELEOPERATED LAND VEHICLES
D. P. Miller 1987 13 p Presented at the IEEE International Conference on Systems, Man, and Cybernetics, Alexandria, Va., 20 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013066; SAND-87-1007C; CONF-8710124-3) Avail: NTIS HC A02/MF A01

This paper describes an experimental methodology for comparing vision systems that might be used to control a teleoperated, land vehicle. A pilot study compared three forward-looking vision systems in two modes of driver interaction: (1) actual remote driving; and (2) video simulation. Remote driving has the advantage of realism, but is subject to variability in driving strategies and can be hazardous to equipment. Video simulation provides a more controlled environment in which to compare vision-system parameters, but at the expense of some realism. If results demonstrate that relative differences among the visual systems are consistent in the two test modes, then subsequent experimentation, aimed at optimizing vision-system parameters will rely on the more cost-effective, video-simulation approach. The results of the pilot study will be discussed in the conference session. DOE

N88-12101# Sandia National Labs., Albuquerque, N. Mex.
STRUCTURAL FREQUENCY FUNCTIONS FOR AN IMPULSIVE, DISTRIBUTED FORCING FUNCTION
V. I. Bateman 1987 30 p Presented at the 58th Shock and Vibration Symposium, Huntsville, Ala., 13 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013811; SAND-87-1369C; CONF-8710126-4) Avail: NTIS HC A03/MF A01

The response of a penetrator structure to a spatially distributed mechanical impulse with a magnitude approaching field test force levels (1 to 2 Mlb) was measured. The frequency response function calculated from the response to this unique forcing function is compared to frequency response functions calculated from response to point forces of about two thousand pounds and a hundred thousand pounds. The results show that the strain gages installed on the penetrator case respond similarly to a point, axial force and to a spatially distributed, axial force. This result suggests that the distributed axial force generated in a penetration event may be reconstructed as a point axial force when the penetrator behaves in a linear manner. DOE

N88-12102# Oak Ridge National Lab., Tenn.
THE 3-D WORLD MODELING FOR AN AUTONOMOUS ROBOT
M. Goldstein, F. G. Pin, and C. R. Weisbin Aug. 1987 26 p

Presented at the SPIE Cambridge Symposium on Intelligent Robots and Computer Vision, Cambridge, Mass., 1 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE87-013878; CONF-871163-1) Avail: NTIS HC A03/MF A01

A methodology is presented for a concise representation of the 3-D world model for a mobile robot, using range data. The process starts with the segmentation of the scene into objects given a unique label, based on principles of range continuity. Then the external surface of each object is partitioned into homogeneous surface patches. Contours of surface patches in 3-D space are identified by estimating the normal and curvature associated with each pixel. The resulting surface patches are then classified as planar, convex or concave. Since the world model uses a volumetric representation for the 3-D environment, planar surfaces are represented by thin volumetric polyhedra. Spherical and cylindrical surfaces are extracted and represented by appropriate volumetric primitives. All other surfaces are represented using the boolean union of spherical volumes (as described in a separate paper by the same authors). The result is a general, concise representation of the external 3-D world, which allows for efficient and robust 3-D object recognition. DOE

N88-12103# Naval Postgraduate School, Monterey, Calif.
MODELS FOR CONDUCTING ECONOMIC ANALYSIS OF ALTERNATIVE FUEL VEHICLES M.S. Thesis
Danny R. Grenier Jun. 1987 75 p
(AD-A184028) Avail: NTIS HC A04/MF A01 CSCL 13F

The present status of alternative fuel vehicles, specifically electric-powered and compressed natural gas-powered vehicles is summarized. Specific advantages and disadvantages of each vehicle type, in comparison to the gasoline-powered vehicle, are reviewed. A life cycle cost model is formulated for each vehicle type. An integer linear program is derived and explained as a means of determining the optimal mix of vehicles for a command's transportation fleet. The models are tested by running several test cases using data from the Naval Postgraduate School transportation office. GRA

N88-12104# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
GAS TUNGSTEN ARC WELDING OF Al-10Fe-5Ce Final Report, Jun. 1983 - Jun. 1986
Guinn E. Metzger Feb. 1987 24 p
(AD-A184202; AFWAL-TR-87-4037) Avail: NTIS HC A03/MF A01 CSCL 13E

A thin sheet of the powder metallurgy aluminum alloy Al-10Fe-5Ce was fusion welded with the gas tungsten arc welding process. The effect of preweld vacuum heat treatment, filler metal, and the type of welding current was investigated. The gross porosity of welds made with untreated base metal was virtually eliminated by the use of a combination of preweld vacuum heat treatment and a direct current electrode negative (DCEN) welding arc with helium shielding gas. The required heat treatment is estimated to be 20 hours at 750 F, which results in a reduction in the base metal tensile strength from about 65 to 60 ksi. However, the presence of brittle phases near the weld interface causes low ductility and low strength. The tensile elongation at room temperature of longitudinal welds was about 1%, and the tensile strength joint efficiency of transverse welds was 55% when tested at room temperature, and 81% at a testing temperature of 600 F. GRA

N88-12105*# Alabama Univ., Huntsville.
TELEOPERATOR AND ROBOTICS SYSTEM ANALYSIS Final Report
William Teoh 30 Sep. 1987 243 p
(Contract NAS8-35670)
(NASA-CR-179220; NAS 1.26:179220) Avail: NTIS HC A11/MF A01 CSCL 13I

The Orbital Maneuvering Vehicle (OMV) was designed to operate as a remotely controlled space teleoperator. The design and implementation of OMM (a mathematical model of the OMV) are discussed. The State Vector Transformation Module (SVX), an interface between the OMV simulation model and the mobile base (TOM-B) of the flat floor simulation system is described. A summary of testing procedures and conclusions are presented together with the test data obtained. B.G.

N88-11800# Joint Publications Research Service, Arlington, Va.
OPERATION OF MULTISTAGE POWER SUPPLIES FOR ELECTRON BEAM WELDING INSTALLATIONS Abstract Only
G. I. Leskov and G. A. Loskutov *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 66 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 9, Sep. 1986 p 40-42, 62 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-12106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLAW IMAGING AND ULTRASONIC TECHNIQUES FOR CHARACTERIZING SINTERED SILICON CARBIDE
George Y. Baaklini (Cleveland State Univ., Ohio.) and Phillip B. Abel Aug. 1987 21 p Presented at the Conference on Nondestructive Testing of High-Performance Ceramics, Boston, Mass., 25-27 Aug. 1987; sponsored in part by American Ceramic Society and the American Society for Nondestructive Testing
(NASA-TM-100177; E-3753; NAS 1.15:100177) Avail: NTIS HC A03/MF A01 CSCL 14D

The capabilities were investigated of projection microfocus x-radiography, ultrasonic velocity and attenuation, and reflection scanning acoustic microscopy for characterizing silicon carbide specimens. Silicon carbide batches covered a range of densities and different microstructural characteristics. Room temperature, four point flexural strength tests were conducted. Fractography was used to identify types, sizes, and locations of fracture origins. Fracture toughness values were calculated from fracture strength and flaw characterization data. Detection capabilities of radiography and acoustic microscopy for fracture-causing flaws were evaluated. Applicability of ultrasonics for verifying material strength and toughness was examined. Author

N88-12107# Technical Research Centre of Finland, Espoo.
REAL TIME ANALYSIS OF THE RESULTS FROM MECHANIZED ULTRASONIC TESTING
Kari Lahdenperae, Aarne Lipponen, and Stefan Sandlin Sep. 1986 35 p In FINNISH
(DE87-752511; VTT-TUTK-434) Avail: NTIS (US Sales Only) HC A03/MF A01

Mechanized ultrasonic testing equipment has been built in Finland's Technical Research Center. The equipment can be used for ultrasonic testing of plates and pipes having a diameter in excess of 200 mm. A large computer program has been written for analyzing results and reporting. A micro/PDP-11 with 512 kbyte central memory, a 10 Mbyte Winchester disk and dual 700 kbyte diskettes have been selected for the computation; the operating system is RT11. Measurements were made with a four channel - computer controlled - ultrasonic device KB 6000. The communication between the computer and the KB 6000 occurs via an interface unit DRV11J. The reporting is made with microprocessor based matrix printer Genicom 3404 working in graphic mode. As a result A-, B- and C-figures are produced from the inspected volume. From these figures two projections of the reflectors as well as the amplitude can be seen. The inspection parameters are also included. Afterwards the results can be reanalyzed from data stored on disc and for example, another reporting level can be used. In the case of four transducers, two figures are printed out. The results from the opposite transducers are printed in the same figure. The measurements are coordinated

using interrupt signals produced by the independent controller of the manipulator. With the VT240 graphic monitor one can get an image of the weld to be tested including the position of the transducers, their scanning movement and of the volume to be inspected. There are also programs to be used for inspecting the base material. DOE

N88-12108 Iowa State Univ. of Science and Technology, Ames.
ELASTODYNAMIC RAY THEORY AND ASYMPTOTIC METHODS FOR DIRECT AND INVERSE SCATTERING PROBLEMS Ph.D. Thesis
Jer-Shi Chen 1987 264 p
Avail: Univ. Microfilms Order No. DA8716749

In ultrasonic nondestructive evaluation (NDE) testing, sound waves are beamed into a material. A flaw present in the material will interupt the incident sound beam and give rise to scattered waves. One important aspect of ultrasonic NDE testing is to use this scattered response to determine the nature of the flaw. Elastodynamic ray theory is employed here to obtain both zeroth and first order asymptotic solutions for the far-field leading edge response of a volumetric scatterer caused by incident longitudinal and transverse waves. The explicit results given here for voids have important implications for the validity of equivalent flaw sizing schemes, such as the inverse Born approximation, and, as shown, can form the basis for new equivalent flaw sizing methods. These results also can be used to develop a more exact flaw sizing algorithm that does not involve any a priori assumption regarding the flaw shape. Other details discussed here include the asymptotic expansions of integrals defined on arbitrary curved surfaces and a unified treatment of the curvature tensors of the reflected and refracted wavefronts; these results are of fundamental importance for the solution of scattering problems via ray theory.
Dissert. Abstr.

N88-12109 Arizona Univ., Tucson.
RELIABILITY-BASED OPTIMAL STRUCTURAL AND MECHANICAL DESIGN Ph.D. Thesis
Seung Joo Lee 1987 208 p
Avail: Univ. Microfilms Order No. DA8716356

The combination of elementary optimization and probabilistic design techniques are discussed. A general strategy is presented for optimization when the design factors are random variables and some or all of the constraints are probability statements. Because analysis algorithms are complicated, a computer code, program RELOPT, was constructed to automate the analysis. Several examples are presented to illustrate the full range of capabilities of RELOPT. The program is validated by checking with independent and exact solutions. An example is presented which demonstrates that the cost of running RELOPT can be substantial as the size of the problem increases. Dissert. Abstr.

N88-12110# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Science.
DURABILITY (LIFETIME) PREDICTIONS ADHESIVELY BONDED STRUCTURES
Hal F. Brinson 21 Jul. 1987 28 p
(Contract N00014-82-K-0185)
(AD-A184069; VPI-E87-18; CAS/ESM-87-6) Avail: NTIS HC A03/MF A01 CSCL 11A

A brief review of past and current methods for life time or durability assessment of engineering structures is given. It is noted that adhesively bonded structures exhibit all the features that compromise the durability of metals and polymers plus additional features related to the interface between the adhesive and the adherend. A discussion of current techniques on adhesives is given which includes moisture diffusion, temperature, and other effects. It is suggested that the critical issue in durability predictions for adhesion science is the development of methods of measuring the properties of the various components in an adhesive joint. A technique based on a new beam test for adhesion is outlined together with a new digital image correlation technique for measuring strain at the micro scale. The integration of these elements into a research technique to address time-dependent properties in situ are discussed. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N88-12111# Edgerton, Germeshausen and Grier, Inc., Idaho Falls. Idaho.
DIFFRACTION MOIRE: THE DYNAMIC REGIME
V. A. Deason, J. S. Epstein, and W. G. Reuter 1987 14 p Presented at the OE/LASE 87, Los Angeles, Calif., 11 Jan. 1987
(Contract DE-AC07-76ID-01570)
(DE87-014883; EGG-M-32286; CONF-870132-17) Avail: NTIS HC A03/MF A01

The technique of diffraction moire interferometry has been applied to numerous static and slowly changing stress configurations. The method has now been extended to the study of dynamic loading events, especially to the interaction of dynamic stress waves with such flaws as cracks or with the variations in composition found in composite materials. A pulsed ruby laser was used to provide the rapid (20 ns wide), brilliant and coherent illumination required for these studies. The technique and several specific applications are described. DOE

N88-12112# Vibration Inst., Clarendon Hills, Ill.
THE SHOCK AND VIBRATION DIGEST, VOLUME 19, NO. 10 Monthly Report
Judith Nagle-Eshleman, ed. Oct. 1987 72 p
Avail: NTIS HC A04/MF A01

The fracture mechanics theory in reliability analysis of structural ceramics is discussed. Also included are abstracts from current literature, book reviews, and the calendar for meetings, seminars, and short courses. For individual titles, see N88-12113 through N88-12113.

N88-12113# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.
APPLICATION OF FRACTURE MECHANICS THEORY IN THE RELIABILITY ANALYSIS OF STRUCTURAL CERAMICS IN MULTIAXIAL LOADING
D. K. Shetty *In* Vibration Inst., The Shock and Vibration Digest, Volume 19, No. 10 Oct. 1987 p 3-19 (For primary document see N88-12112 03-39)
Avail: NTIS HC A04/MF A01

Structural ceramics fail from cracklike flaws that vary widely in size, shape, and orientation. The strength of ceramics and the design stresses for their application are based on a reliability analysis that combines three elements: linear elastic fracture mechanics theory that relates fracture stress to the size, shape, and orientation of the strength-controlling crack; a characteristic crack size distribution that accounts for the size effect on the strength via the weakest-link concept; and a time dependent variation of strength caused by subcritical growth of cracks or some other mechanisms. Recent research was reviewed which has focused on application of fracture mechanics theory in treating failure of structural ceramics from arbitrarily oriented cracks and use of mixed-mode fracture criteria in reliability analysis of structural ceramics to account for size and stress-state effects on strength. Recent experimental results on mixed-mode fracture of ceramics obtained with large macroscopic through-cracks and small microscopic (indenter) surface cracks are discussed in relation to known mixed-mode fracture criteria. Effects of material microstructure stress state are shown to significantly affect the mixed-mode fracture. Author

N88-12114# European Space Agency, Paris (France).
CRACK INITIATION AND PROPAGATION DUE TO CYCLIC THERMAL GRADIENTS
Pierre-Marie Lesne Sep. 1987 182 p Transl. into ENGLISH of Amorcage et Propagation de Fissures sous Gradients Thermiques Cycliques (Chatillon, France) Original language document was previously announced as N87-13829
(ESA-TT-1023; ONERA-P-1985-2; ETN-87-91112) Avail: NTIS HC A09/MF A01

Tests were made on a simple thin plate of IN100 superalloy approximating the shape of a turbine blade, in which crack initiation and propagation by thermal fatigue were produced, to develop a method for predicting the creep-fatigue lifetime of such structures under variable temperature conditions. A finite element method including cyclic viscoplastic constitutive equations was used to calculate the stresses and plastic strains at every point on the blade at successive cycles, using the temperature distribution maps and variable-temperature constitutive equations as given data. The crack initiation can be calculated from the variable-temperature fatigue damage and creep laws, using the hysteresis loop at the stabilized (12th) cycle. Crack propagation, carefully measured during the tests, is predicted by a method based on linear fracture mechanics, taking the viscoplastic behavior of the material into account. The calculation/test comparison is good for initiation and propagation. ESA

N88-12115# European Space Agency, Paris (France).
INVESTIGATION OF RELIABILITY OF STRENGTH VALUES MEASURED ON CFRP TEST BARS BY STATISTICAL METHODS. PART 1: PROBABILITY DISTRIBUTIONS FOR STRENGTH ANALYSIS
Lutz vonBonin and Wolfgang Ganz Jun. 1987 128 p Transl. into ENGLISH of Die Untersuchung der Vertrauenswuerdigkeit von Gemessenen Festigkeitswerten an Probestaeben aus CFK mit Hilfe Statistischer Methoden. Teil 1: Wahrscheinlichkeitsverteilungen fuer die Festigkeitsanalyse (Brunswick, Germany) Original language document was previously announced as N87-18136
(ESA-TT-1036; DFVLR-Mitt-86-17; ETN-87-91115) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 42

Statistical distribution of order-value analysis, of the corresponding estimation functions for the plotted positions of the estimated value of the total frequency to be allocated to each observed value (fracture probability), of probability models particularly relevant to material testing, of graphic/numerical data analysis and the estimation of characteristic values, and the reliability of life predictions are reviewed. Computer and plotter programs make it possible to display Gaussian normal distribution, log normal distribution, and Weibull distribution together with their distribution laws, characteristic degrees of scatter, parameters of form, position and scale, and curve patterns for distribution density, distribution function, and failure rate, and the corresponding probability networks including measurement points, regression lines and reliability limits. ESA

N88-12116 Akron Univ., Ohio.
EFFECTS OF STATE RECOVERY ON CREEP BUCKLING INDUCED BY THERMOMECHANICAL LOADING Ph.D. Thesis
Steven M. Arnold 1987 401 p
Avail: Univ. Microfilms Order No. DA8716207

Structural alloys embody internal mechanisms that allow recovery of state with varying stress at elevated temperature, i.e., they can return to a softer state following periods of hardening. State recovery is known to influence structural response strongly under some important thermomechanical loadings, for example that involving thermal ratchetting or that involving creep cracking. The influence of dynamics and thermal recovery on the creep buckling of a column and of an axisymmetric cylindrical shell under variable axial loading is investigated. The viscoplastic constitutive model employed incorporates a representation of dynamic and thermal (state) recovery. Material parameters are chosen to characterize Narloy Z, a representative copper alloy used in thrust nozzle liners of reusable rocket engines. Variable thermal histories are investigated. The results show that state recovery can significantly affect creep buckling under variable thermomechanical loading. Failure to account for state recovery in constitutive relations can lead to nonconservative prediction of the critical time to creep buckling. A quantification of the potential for numerical stiffness of the specific viscoplastic model is addressed. Dissert. Abstr.

N88-12117 Lehigh Univ., Bethlehem, Pa.
SCALING OF SIZE/TIME/TEMPERATURE ASSOCIATED WITH DILATATION AND DISTORTION IN UNIAXIAL SPECIMENS Ph.D. Thesis
Ching-Kong Chao 1987 121 p
Avail: Univ. Microfilms Order No. DA8714659

The interaction of size/time/temperature in a cylindrical bar that is subjected to monotonically increasing tensile or compressive stress in the longitudinal direction was investigated. Thermal and mechanical behavior are considered to be intertwined as a result of the continuous exchange of surface and volume energy. Energy dissipated to cause subcritical material damage at the microscopic and macroscopic scale can thus be determined by analyzing the transient thermal/mechanical response from .001 to 100 sec while the element sizes can change from .001 to .1 cm at a global displacement rate of approximately .00002 m/sec. Under increasing tensile or compressive load, the temperature at a given location tends to oscillate with decreasing amplitude as the region, over which the observation is made, is reduced in size. For the tensile specimen, failure tends to initiate at the specimen center and coincides closely with the total final separation of the material. Discussed in detail are the distinctly different responses of the tensile and compressive specimens that are reflected by the way with which size/time/temperature interact. Dissert. Abstr.

N88-12118 Cornell Univ., Ithaca, N.Y.
AN INTEGRAL EQUATION ANALYSIS OF INELASTIC SHELLS Ph.D. Thesis
Bimal Poddar 1987 121 p
Avail: Univ. Microfilms Order No. DA8708987

An integral equation approach is presented for the analysis and determination of numerical solutions for the deformation of shells of arbitrary shape subjected to arbitrary loading. The mathematical model is derived by transformation of the 3-D equations from the Cartesian to the appropriate curvilinear coordinates of the shell. Besides transforming the 3-D equations to the shell midsurface, some assumptions are made in order to take advantage of the shell being thin. These assumptions are mainly concerned with the specification of the load on the edges and kinematic assumptions for the dependence of the displacements on the thickness coordinate of the shell. Numerical implementation of the integral equation approach was carried out for axisymmetric inelastic shells. The results for the linear elastic deformation of axisymmetric shells for several examples of toroidal and cylindrical shells were compared against exact elasticity solutions in many cases. Inelastic results for cylindrical and toroidal shells under different load histories are also presented. The results for the inelastic cylindrical shell are compared against a semi-analytical solution based on Love-Kirchoff theory.
Dissert. Abstr.

N88-12119 Georgia Inst. of Tech., Atlanta.
NONLINEAR THERMOVISCOELASTIC ANALYSIS OF METALLIC PLANE CURVED BEAMS Ph.D. Thesis
John Martin Stubstad 1987 191 p
Avail: Univ. Microfilms Order No. DA8715821

An analytic methodology to examine the effects of spatial or temporal variations in temperature on the behavior of mechanically loaded thin structural elements employed at elevated temperatures is presented. The kinematic formulation is suitable for moderate to large rotations of cross sections, provided centroidal axis strains are small. Nonlinearity in the material response, accounting for the dependence of the elevated temperature creep on the thermo-mechanical history, is included through the use of a hereditary type viscoplastic constitutive law. However, the methodology is completely general, allowing any linear or nonlinear

differential constitutive law to be used. The solution methodology is predicated on the assumption of quasi-static response thus decoupling the governing differential equations into a set of interrelated boundary value and initial value problems. Based on results from parametric studies it is demonstrated that temperature variations through the depth exert considerable influence on element behavior when temperature of the element varies with time. The methodology is useable for problems where the buckled state of the element is symmetric in form. Dissert. Abstr.

N88-12120 Georgia Inst. of Tech., Atlanta.
FREQUENCY DOMAIN IDENTIFICATION OF STRUCTURAL DYNAMIC SYSTEMS WITH GENERAL DAMPING MATRICES Ph.D. Thesis
Yi-Pen Cheng 1987 195 p
Avail: Univ. Microfilms Order No. DA8715813

The problems associated with identification of structural dynamic systems with general viscous damping matrices are studied. Methods which modify an a priori mass, damping and stiffness matrices based on measured complex or real modal data are developed. The modified model is such that it reproduces the experimental modal data and it deviates the least from the analytical model in a weighted sense. Several procedures to accomplish this are studied. Results from the different methods were compared. Solution procedures of the methods were simplified when the structures have only real mode shapes. In this case, the methods developed combined with other existing methods give the analyst a variety of models to choose from for further investigations of structural behavior. Dissert. Abstr.

N88-12121 Virginia Polytechnic Inst. and State Univ., Blacksburg.
IDENTIFICATION OF LINEAR STRUCTURAL MODELS Ph.D. Thesis
Nelson Glenn Creamer 1987 132 p
Avail: Univ. Microfilms Order No. DA8712373

To overcome typical problems associated with existing structural model identification methods, a novel identification technique is developed to determine the mass, damping, and stiffness matrices of an undamped, lightly damped, or significantly damped structure from a small set of measurements of both free-response data and forced response data. The identification method is first developed for undamped structures. Through use of the spectral decomposition of the frequency response matrix and the orthogonality properties of the mode shape, a unique identification of the mass and stiffness matrices is obtained. The method is also shown to be easily incorporated into a substructure synthesis package for identifying high order systems. The method is then extended to include viscous damped structures. A matrix perturbation approach is developed for lightly damped structures, in which the mass and stiffness matrices are identified using the imaginary components of the measured eigenvalues and the damping matrix is obtained for the real components of the measured eigenvalues. For significantly damped structures, the mass, damping, and stiffness matrices are identified simultaneously. Dissert. Abstr.

N88-12122 South Carolina Univ., Columbia.
SPREAD OF PLASTIC DEFORMATION IN NOTCHED AND CRACKED PLATES Ph.D. Thesis
Chiachung Lee 1987 165 p
Avail: Univ. Microfilms Order No. DA8714970

A digital image processing based experimental technique is developed to study the plasticity behavior at the front of a stress raiser in a metal specimen. Effective strains within a plastically deformed specimen are obtained using a computer vision system with a feature extraction technique. The procedure was applied to V-notched 304 stainless steel plates. Plastic zone size, shape, and effective strain distribution inside the plastic zone for various loading levels were experimentally determined. Good agreement was obtained when compared to results obtained using an elastic-plastic finite element analysis. A fatigue cracked plate was also investigated. The effective strain distribution around the crack tip is obtained in a full field manner. Various fracture parameters, such as the J-integral and plastic zone size, were obtained and compared with results obtained from the analytical solutions. The implications of the results relative to the presences or absences of a J-controlled crack tip field in the large scale yielding case is discussed. Dissert. Abstr.

N88-12123 Brown Univ., Providence, R. I.
COMPUTATIONAL METHODS AND RESULTS FOR DYNAMIC FRACTURE Ph.D. Thesis
Toshio Nakamura 1987 123 p
Avail: Univ. Microfilms Order No. DA8715541

Developments in the use of the crack tip energy flux integral in computational dynamic fracture mechanics over the past few years is reviewed. The main purpose is to determine conditions under which the value of J at initiation may be inferred from measurable quantities in an experiment. To this end, J is determined from computed field quantities from an expression suitable for finite element procedures. The value of J is also computed in terms of measurable quantities using an appropriate deep-crack formula, and implications for fracture testing of tough materials at relatively high loading rates are discussed. Calculations were performed for typical specimen dimensions and material properties of a high-strength structural steel. A plane strain model is considered. Full geometrical effects are studied with a full-field three-dimensional finite element analysis. Dissert. Abstr.

N88-12124 Lehigh Univ., Bethlehem, Pa.
KINETICS OF CRACK GROWTH: THERMAL/MECHANICAL INTERACTION Ph.D. Thesis
Da-Yu Tzou 1987 207 p
Avail: Univ. Microfilms Order No. DA8714687

The growth characteristics of a central crack in a panel subjected to monotonic and symmetric load were examined. A constant rate of tensile stress is applied such that the crack is made to grow incrementally in accordance with the energy density theory that simultaneously accounts for the stress and failure analysis. The time dependent stresses and strains near the tip of a growing crack were obtained and compared with those found from the theory of plasticity. A higher local strain rate is predicted by the energy density theory as a result of not neglecting the effect of dilatation. The difference in the path of loading and unloading distinguishes the energy dissipated from that used to advance the crack. Threshold values in the surface and volume energy density determine the extent of crack growth. Presented graphically are the fluctuations in the local temperature that tend to increase in amplitude as the slowly growing crack approaches the onset of rapid fracture. The mutual interaction of the mechanical and thermal effects that are included in the energy density theory are considered to be essential for characterizing the state of affairs near the crack tip. Dissert. Abstr.

N88-12125*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
COMPARISON OF MEASURED TEMPERATURES, THERMAL STRESSES AND CREEP RESIDUES WITH PREDICTIONS ON A BUILT-UP TITANIUM STRUCTURE
Jerald M. Jenkins Nov. 1987 28 p
(NASA-TM-86814; H-1354; NAS 1.15:86814) Avail: NTIS HC A03/MF A01 CSCL 20K

Temperature, thermal stresses, and residual creep stresses were studied by comparing laboratory values measured on a built-up titanium structure with values calculated from finite-element models. Several such models were used to examine the relationship between computational thermal stresses and thermal stresses measured on a built-up structure. Element suitability, element density, and computational temperature discrepancies were studied to determine their impact on measured and calculated thermal stress. The optimum number of elements is established from a balance between element density and suitable safety margins, such that the answer is acceptably safe yet is economical from a computational viewpoint. It is noted that situations exist where relatively small excursions of calculated temperatures from

measured values result in far more than proportional increases in thermal stress values. Measured residual stresses due to creep significantly exceeded the values computed by the piecewise linear elastic strain analogy approach. The most important element in the computation is the correct definition of the creep law. Computational methodology advances in predicting residual stresses due to creep require significantly more viscoelastic material characterization. Author

N88-12126# Queensland Univ., St. Lucia (Australia). Dept. of Civil Engineering.
BREAKING WAVE FORCES ON VERTICAL CYLINDERS
C. J. Apelt and J. Piorewicz May 1986 102 p
(RR-CE71) Avail: NTIS HC A06/MF A01

The forces and moments due to wave action on vertical cylinders and rows of cylinders in and near the breaking zone were measured. The range of wave steepness, 0.01 less than or = H(0)/L(0) less than or = 0.05, and the range of relative cylinder diameter, 0.5 less than or = D/H(0) less than or = 2.5, were used in experiments. Empirical formulae were developed, with D/H(0) as an independent parameter, for prediction of the breaking wave force and moment with 1% probability of exceedance. The influence of neighbor cylinders on the magnitude of this force was also considered. Author

N88-12127# Sandia National Labs., Albuquerque, N. Mex.
CONSERVATISM IMPLICATIONS OF SHOCK TEST TAILORING FOR MULTIPLE DESIGN ENVIRONMENTS
T. J. Baca, R. G. Bell, and S. A. Robbins 1987 20 p Presented at the 58th Shock and Vibration Symposium, Huntsville, Ala., 13 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013927; SAND-87-1441C; CONF-8710126-3) Avail: NTIS HC A02

Specification of a mechanical shock test requires an engineering decision concerning the relationship between the laboratory and field shock environments. Once a method of shock characterization is selected, test conservatism becomes a measure of the degree to which the laboratory test is more severe than the operational environment of the structure being tested. Described is a method for analyzing shock conservation in test specifications which have been tailored to qualify a structure for multiple design environments. Shock test conservatism is quantified for shock response spectra, shock intensity spectra and ranked peak acceleration data in terms of an Index of Conservatism (IOC) and an Overtest Factor (OTF). The multi-environment conservatism analysis addresses the issue of both absolute and average conservatism. The method is demonstrated in a case where four laboratory tests have been specified to qualify a component which must survive seven different field environments. Final judgment of the tailored test specification is shown to require an understanding of the predominant failure modes of the test item. DOE

N88-12128# Crystal Growth and Materials Testing Associates, Lanham, Md.
DEFORMATION MECHANISMS OF THERMOSTRUCTURAL MATERIALS Final Report, 20 May 1985 - 20 May 1987
R. J. Arsenault, N. Louat, P. Shahinian, A. K. Singh, and T. Chaki 20 Jul. 1987 46 p
(Contract N00014-85-C-2240)
(AD-A184070; Rept-162) Avail: NTIS HC A03/MF A01 CSCL 11F

In this final report are discussed the results obtained in a two year investigation by Crystal Growth and materials Testing Associates of the deformation mechanisms of thermostructural materials. This report is divided into three portions: (1) Some effects of the presence of particles near free surfaces; (2) Improvement of turbine blades and other components by hot isostatic pressing; and (3) Thermal and thermo-mechanical fatigue of superalloy Rene 80 coated with CoCrAlY. GRA

N88-12129# Case Western Reserve Univ., Cleveland, Ohio.
A PROBABILISTIC MODEL OF BRITTLE CRACK FORMATION Interim Report, Apr. 1986 - Mar. 1987
Alexander Chudnovsky, Boris Kunin, and Abdelsamie Moet Jun. 1987 30 p
(Contract N00014-86-K-0285)
(AD-A184423) Avail: NTIS HC A03/MF A01 CSCL 20K

Probability of a brittle crack formation in an elastic solid with fluctuating strength is considered. A set omega of all possible crack trajectories reflecting the fluctuation of the strength field is introduced. The probability P(X) that crack penetration depth exceeds X is expressed as a functional integral over omega of a conditional probability of the same event taking place along a particular path. Various techniques are considered to evaluate the integral. Under rather non-restrictive assumptions we reduce the integral to solving a diffusion type equation. Here a new characteristic of fracture process, crack diffusion coefficient, is introduced. Then an illustrative example is considered where the integration is reduced to solving an ordinary differential equation. GRA

N88-11798# Joint Publications Research Service, Arlington, Va.
RESISTANCE OF WELDED JOINTS IN HIGH TEMPERATURE HASTELLOY N-TYPE NICKEL ALLOY TO HOT CRACK FORMATION Abstract Only
K. A. Yushchenko, V. N. Lipodayev, M. V. Belchuk, G. N. Gordan, and O. V. Novichkova *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 64 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 9, Sep. 1986 p 10-12 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

N88-11799# Joint Publications Research Service, Arlington, Va.
STRESS STATE OF WELDED JOINTS OF DISSIMILAR MATERIALS OBTAINED BY DIFFUSION WELDING Abstract Only
Ya. V. Lyamin, R. A. Musin, and V. N. Ivanov *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 65 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 9, Sep. 1986 p 13-17 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

N88-11875# Joint Publications Research Service, Arlington, Va.
GENERALIZED COUPLED-MODE EQUATIONS, APPLICATIONS TO FIBER COUPLERS
Jingren Qian *In its* China report: Science and Technology 9 Apr. 1987 p 34-38 Transl. into ENGLISH from Zhongguo Kexue Jishu Daxue Xuebao (Hefei, Peoples Republic of China), v. 16, no. 4, Dec. 1986 p 427-431 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

N88-11895# Joint Publications Research Service, Arlington, Va.
GENERALIZED HYBRID VARIATIONAL PRINCIPLE, CORRESPONDING FINITE ELEMENT MODEL
Wanji Chen *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 42-50 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 7, no. 5, May 1986 p 443-449 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

N88-11899# Joint Publications Research Service, Arlington, Va.
COMBINED CALCULATION OF DEFORMATION AND STRESS FOR THE BODY AND SABOT OF AN APFSDS
Mingang Qian *In its* JPRS Report: Science and Technology. China 28 Aug. 1987 p 12-20 Transl. into ENGLISH from Binggong Xuebao (Beijing, People's Republic of China), no. 3, Aug. 1986 p 28-34 (For primary document see N88-11897 03-31)
Avail: NTIS HC A06/MF A01

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-12130# California Univ., Berkeley. Lawrence Berkeley Lab.
ILLUSTRATIONS OF A DENSITY-EQUALIZING MAP PROJECTION TECHNIQUE
S. Selvin, D. Merrill, J. Schulman, G. Shaw, W. Benson, and M. Mohr Apr. 1987 43 p Prepared in cooperation with California Univ., Berkeley and California Birth Defects Monitoring Program, Berkeley
(Contract DE-AC03-76SF-00098)
(DE87-013992; LBL-23189) Avail: NTIS HC A03

To analyze geographic clusters of disease, one must consider varying population density. Customary methods, i.e., calculation of rates for subregions, are unsatisfactory: if subregions are too large, geographic detail is lost; if too small, stable rates cannot be calculated. In either case, adjacency relationships among cases are not easily analyzed. The usual difficulties are avoided by using an innovative projection technique. On a transformed map, population density is equalized while preserving adjacency relationships, so that clusters of cases can be easily recognized and their statistical significance measured. A density-equalizing computer algorithm is briefly described, and its use illustrated in representative applications. DOE

N88-12131# European Space Agency, Paris (France).
COMMERCIAL OPPORTUNITIES FOR REMOTE SENSING WITH POLAR PLATFORMS
T. D. Guyenne, comp. and J. J. Hunt, comp. Apr. 1987 75 p Workshop held in Frascati, Italy, 4-5 Sep. 1986
(ESA-SP-269; ISSN-079-6566; ETN-87-90866) Copyright Avail: NTIS HC A05/MF A01

Commercial use of the Columbus Polar Platforms; payload configurations and serviceability; interoperability and integration of data relay satellite systems; legal protection of Polar Platform users; confidentiality of data; market potential for commercial remote sensing; commercial perspectives of an imaging spectrometer program; remote sensing user requirements; an advanced microwave imaging radiometer; and an X-band SAR for a European remote sensing payload were discussed. For individual titles, see N88-12132 through N88-12142.

N88-12132# European Space Agency, Paris (France).
POSSIBLE COMMERCIAL USE OF THE POLAR PLATFORMS
Anne-Marie Hieronimus *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 7-9 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

Conditions to be fulfilled for commercial use of the Columbus Polar Platforms are outlined. The legal position, selection procedures, and pricing policy are discussed. ESA

N88-12133# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Directorate of Earth Observation and Microgravity.
PAYLOAD CONFIGURATIONS AND SERVICEABILITY c18
N. deVilliers *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 11-16 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

A Columbus Polar Platform scenario for Earth observations is outlined. It features: 2 platforms in coordinated Sun-synchronous orbits at an altitude of 800 km: 1 in a morning orbit, with a descending node between 09.30 and 10.30, and the other in an afternoon orbit, with an ascending node between 13.00 and 14.30; a multidisciplinary payload divided between the platforms with 2.4 tons per platform and the capability for further growth; and servicing every 3 yr for maintaining the capabilities, adding new payloads, and upgrading payloads. Data rates up to several hundred megabits/sec are compatible with: direct downlinking, and the proposed European Data Relay Satellite System. Lower data rates generated globally are compatible with on-board recording techniques. The methods for acquiring the data on the ground are compatible with the delivery time requirements for the different applications. ESA

N88-12134# European Space Agency, Paris (France). Directorate of Telecommunications Programs.
INTEROPERABILITY AND INTEGRATION OF DATA RELAY SATELLITE SYSTEMS c18
G. Barretta *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 17-25 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

Interoperability of American, European and Japanese data relay satellite (DRS) networks is discussed, emphasizing the role of the Columbus space station. Six interoperability options, ranging from independently designed systems with S-band compatibility to systems which share frequencies and are fully coordinated, are presented. Antenna designs to prevent the LEO spacecraft body blocking the link between the LEO spacecraft antenna and the DRS location, are suggested. ESA

N88-12135# European Space Agency, Paris (France). Legal Affaires Div.
LEGAL PROTECTION OF THE POLAR PLATFORM'S USERS c84
A. Vahrenwald *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 27-34 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

Legal problems faced by the user of Columbus Polar Platforms for remote sensing are reviewed. International law, international law of outer space, the legal regime of the space station system, the U.S. Land Remote-Sensing Commercialization Act of 1984, copyright law, the law of unfair competition, and the legal obligations by which a user may attempt to bind purchasers are discussed. ESA

N88-12136# Hunting Technical Services Ltd., Borehamwood (England).
CONFIDENTIALITY OF DATA c84
J. W. Trevett *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 35-37 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

It is argued that exclusive rights to data are more important than confidentiality for the Columbus Polar Platform remote sensing observations. For the on-board instrumentation and the ground segment, normal patent and copyright laws protect both hardware and software developments. For the data, the open skies policy continues to apply and as with existing satellites, confidentiality will not be a problem. ESA

N88-12137# ERSAC Ltd., Livingston (England).
MARKET POTENTIAL FOR COMMERCIAL REMOTE SENSING
G. C. Stove *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 39-45 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

Remote sensing applications, market areas, payloads, sensor concepts, and data handling are reported on, together with the results of a commercial questionnaire which perceived a market growth varying from 10% to 20% in the near term. Really significant growth and a demand for future data and services depend on a bold preparatory and market development program. Pilot project fields are listed and a business development strategy for such preparatory programs is suggested. ESA

N88-12138# Logica Ltd., Cobham (England).
COMMERCIAL PERSPECTIVE OF AN IMAGING SPECTROMETER DEVELOPMENT PROGRAM
D. C. Ferns *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 49-54 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

The costs of commercial payload development programs are shown to be orders of magnitude greater than the revenue that might be expected from image and data product sales. The criteria by which an instrument is judged to have commercial potential are defined, and the reasons for the choice of an imaging spectrometer are given. ESA

N88-12139# Compagnia Italiana Servizi Tecnici, Rome.
AN OVERVIEW OF REMOTE SENSING USERS' REQUIREMENTS
G. Avanzi and R. Grazi *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 55-57 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

User requirements in cartography and thematic mapping are discussed. Lack of education of the end users and lack of confidence in available performances of systems and information content of products are identified as weaknesses in the commercialization of value added services in remote sensing. ESA

N88-12140# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.
MBB-ERNO VIEW OF REMOTE SENSING COMMERCIALIZATION
B. Kunkel *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms (data) Apr. 1987 p 59-62 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

Commercial prospects for the Modular Optoelectronic Multispectral Scanner and Reflective Optics System Imaging Spectrometer derivatives are assessed. Prospects in terms of revenues are considered limited to pay off investments before the year 2000. ESA

N88-12141# Selenia S.p.A., Rome (Italy).
THE CNR/PSN ADVANCED MICROWAVE IMAGING RADIOMETER (AMIR)
E. Antonucci, E. Nisi, and R. Somma *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 63-66 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

The feasibility of an advanced microwave imaging radiometer for oceanographic and atmospheric applications was studied. In order to measure sea surface wind speed, rain rate, sea surface temperature, soil moisture, atmospheric water content, snow cover, and sea ice extension and age, an instrument operating at 5, 10, 18, 22, and 37 GHz, all dual polarized, is needed. An open Cassegrain antenna, and a near total power receiver are selected. ESA

N88-12142# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
X-BAND SAR FOR A EUROPEAN REMOTE SENSING PAYLOAD
H.-M. Braun and W. Kriegl *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 67-69 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

The conceptual layout of an X-band SAR for the Columbus Polar Platform is presented. Together with an upgraded version of the ERS-1 SAR in C-band, which could be also developed for the Polar Platform, it could provide dual frequency/dual polarization SAR images from space. The X-SAR is primarily a replica of the Shuttle X-SAR to be launched together with SIR-C. ESA

N88-12143# Centre National d'Etudes Spatiales, Toulouse (France).
SPOT 1: FIRST IN-FLIGHT RESULTS
1987 336 p Partly in ENGLISH and FRENCH Lecture course presented in Toulouse, France, Dec. 1986 Original contains color illustrations
(ISBN-2-85428-177-2; ETN-87-90895) Copyright Avail: CEPADUES-Editions, Toulouse, France

Operational use of SPOT satellite imagery for urban research; mapping; water resources studies; geology and mineral exploration; agriculture; forestry; and coastal and oceanographic studies was discussed. Image processing and image commercialization were considered. For individual titles, see N88-12144 through N88-12179.

N88-12144# Centre National d'Etudes Spatiales, Toulouse (France). SPOT Image.
DEVELOPMENT OF THE SPOT COMMERCIAL SERVICE: PRELIMINARY CONCLUSIONS AFTER SIX MONTHS OF OPERATIONS
Andre Fontanel *In its* SPOT 1: First In-Flight Results 1987 p 11-17 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

After 6 months operation, 200,000 SPOT scenes were recorded and archived. Their characteristics, location, and cloud cover parameters are referenced in the central catalog on a 24 hr per day basis. The spacecraft operated with very few incidents, except tape recorder 1 which is in the standby position. Ground system operation is very smooth. Adjustments, however, were necessary for the payload scheduling activities, which directly depend on data collection needs expressed by the user community. The extremely versatile flexibility of the SPOT system with respect to imaging capabilities proved demanding in terms of conflicts management, imaging strategy, etc. Distribution of images to the user community worldwide is increasing, with digital data representing 44 percent of products. Production and management problems particularly in the areas of quick look quality and photographic production were treated. User response is extremely positive. ESA

N88-12145# Satimage, Kiruna (Sweden).
SATIMAGE AND THE NORDIC SPOT MARKET **c29**
Lars Bjerkesjoe *In* CNES, SPOT 1: First In-Flight Results 1987 p 19-24 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Swedish participation in the SPOT program is outlined. The ground segment and the image production chain are described. Customer services and marketing are discussed. ESA

N88-12146# SPOT Image Corp., Washington, D.C.
SPOT IMAGE CORPORATION: EARLY RESULTS **c29**
David S. Julyan *In* CNES, SPOT 1: First In-Flight Results 1987 p 25-31 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Commercialization of SPOT satellite images in the United States is described. Customer reactions and possible competition are discussed. ESA

N88-12147# Canada Centre for Remote Sensing, Ottawa (Ontario).
THE CANADIAN SPOT PROGRAM **c14**
R. A. ONeil *In* CNES, SPOT 1: First In-Flight Results 1987 p 33-40 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The SPOT ground stations and operations center in Canada are described. The image production system is outlined. ESA

N88-12148# Institut Geographique National, Paris (France).
FIRST ASSESSMENT OF PROCESSING AND USE OF SPOT IMAGES BY THE INSTITUT GEOGRAPHIQUE NATIONALE
Alain Baudoin *In* CNES, SPOT 1: First In-Flight Results 1987 p 41-47 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Use of SPOT images for cartography is described. Geometrical rectification gives images compatible with geographic information systems. Radiometric corrections are provided to generate true colors from multispectral imagery. Three dimensional synthetic images are produced from rectified images and thematic studies on land use cover, urban studies, forest fires inventories, etc. are underway. ESA

N88-12149# Centre National d'Etudes Spatiales, Toulouse (France).
RESULTS OF THE SATELLITE AND THE TOULOUSE (FRANCE) RECEIVING STATION OPERATOR
P. Warlop, F. Forestier, G. Guepet, J. F. Lemauf, and F. Giniaux *In its* SPOT 1: First In-Flight Results 1987 p 49-54 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The SPOT satellite and ground station performance are reviewed. The in orbit behavior of SPOT satellite bus is nominal. Only a few temporary failures on the payload are reported. The only persistent failure concerns one of the two on-board recorders. The functioning of mission and control center is nominal and the Mission Center is evolving to better meet customer programming requests. The image rectification center is running nominally for the archiving of whole scenes. The quantity of SPOT products made, mainly level 1, is growing by 65 per day and so meets the specifications. ESA

N88-12150# Centre National d'Etudes Spatiales, Toulouse (France).
SIGNAL TO NOISE RATIOS **c32**
Gerard Begni *In its* SPOT 1: First In-Flight Results 1987 p 57-61 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Noise in SPOT images generated by electronic devices is analyzed. The specifications and the performances measured during the post-launch assessment period are presented. The result is excellent in the multispectral bands; in the panchromatic bands, the specifications may not be met in very specific cases. The structure of the noise is discussed. ESA

N88-12151# Centre National d'Etudes Spatiales, Toulouse (France).
DETECTOR NORMALIZATION **c32**
Marc Leroy *In its* SPOT 1: First In-Flight Results 1987 p 63-69 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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Residual errors in the SPOT detector normalization preprocessing are discussed. The specifications, the radiometric preprocessing algorithm, the methods of measurement of the normalization coefficients, and the results are presented. A method of deriving normalization coefficients using on-board calibration proves infeasible, but a method based on snow covered sites works. Analysis shows that residual errors are within specifications, and can be corrected. ESA

N88-12152# Centre d'Etudes et de Recherches, Toulouse (France).
ABSOLUTE AND INTERBAND CALIBRATION [ETALONNAGE ABSOLU ET INTERBANDE] **c19**
Magdeleine Dinguirard *In* CNES, SPOT 1: First In-Flight Results 1987 p 71-78 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Calibration of SPOT imagers is described. The absolute calibration provides the proportionality coefficient between the scene radiance and the normalized numerical output. During the in-flight assessment period, atmospheric and reflectance measurements over the White Sands test site were used to calculate these absolute coefficients (one by spectral band). The site radiance collected by the HRV was estimated, using an atmospheric radiative transfer model. On board, the absolute calibration is performed by a fiber optics unit which projects exoatmospheric solar irradiance onto detectors in each band. White Sands measurements determine the in orbit characteristics of this fiber unit. The 10 percent specified accuracy in absolute calibration is met. The interband calibration is deduced from these measurements taking the green band (XS1) as a reference. The systematic uncertainties are thus eliminated and the specified interband calibration accuracy of 3 percent verified. ESA

N88-12153# Centre d'Etudes et de Recherches, Toulouse (France).
MODULATION TRANSFER FUNCTION **c35**
D. Leger *In* CNES, SPOT 1: First In-Flight Results 1987 p 79-82 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The modulation transfer function (MTF) was assessed, in the panchromatic mode, using a visual comparison between SPOT images and images from a reference catalog, made using aerial high resolution photographs over cities. The photographs were digitized, deteriorated by application of known MTF, and put in SPOT format. The comparison indicates that the two HRV cameras are within the specifications. The calculation of the image frequency content when the two HRVs are in parallel viewing allowed direct comparison between the cameras. ESA

N88-12154# Centre National d'Etudes Spatiales, Toulouse (France).
INTRINSIC AND EXTRINSIC GEOMETRIC QUALITY **c74**
B. Boissin and J.-P. Gardelle *In its* SPOT 1: First In-Flight Results 1987 p 83-91 (For primary document see N88-12143 03-43)
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The method used to check the viewing geometry of the SPOT satellite after launch and to estimate the geometric image quality is outlined. Results obtained during the first months of satellite operation show that the extrinsic and intrinsic quality of the SPOT products meet the specifications most of the time: infrared horizon disturbances may degrade level 1B image location (up to 2000 m). Anisomorphism may also be slightly over the specification. ESA

N88-12155# Institut Geographique National, Paris (France).
REGISTRATION OF SPOT IMAGES [LA SUPERPOSABILITE DES IMAGES SPOT]
D. Pradines *In* CNES, SPOT 1: First In-Flight Results 1987 p 93-102 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The in-flight tests of SPOT 1 satellite were used to control whether the system meets the specifications, designed to obtain an image quality compatible with thematic uses. Part of the controls was based on image geometry. Methods developed to test are: (1) multitemporal image registration which characterizes the quality of the level S products; and (2) multispectral registration which has an important role in the quality of color composite images, based on automatic correlation. In simultaneous acquisition of

panchromatic and multispectral data, the registration of the two images is facilitated by the viewing geometry. This leads to an automatic algorithm to register the two images. In data acquisition with both instruments in twin mode, the geometric quality of the SPOT images gives the possibility of obtaining mosaics automatically from SPOT images keeping the geometric quality of the final product. ESA

N88-12156# Institut Geographique National, Paris (France).
EVALUATION OF SPOT STEREOSCOPIC POSSIBILITIES FOR CARTOGRAPHY **c35**
Patrice Denis, Anne-Claire deGaujac, Patrick Gigord, and Vincent Rodriguez *In* CNES, SPOT 1: First In-Flight Results 1987 p 103-108 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The stereoscopic capacities of SPOT 1 were checked using two test areas equipped with control points and check points before the launching of the satellite. Measures were performed on an analytical stereoplotter to check specifications (10 m) for height determination. Raw results lead to a mean square residual of 7.1 m and final results lead to a mean square residual of 5.3 m. The cartographic nature of SPOT is thus confirmed. ESA

N88-12157# Institut Geographique National, Paris (France).
FEASIBILITY STUDY OF A RANGE OF PRODUCTS DRAWN FROM SPOT SATELLITE IMAGERY AND SPECIFIC TO ROAD-LAYING STUDIES
M. Doridot and M. Pausader *In* CNES, SPOT 1: First In-Flight Results 1987 p 113-119 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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Use of SPOT satellite imagery for road making in developing countries is considered. In subdesert regions SPOT images are useful for detecting road construction materials, for analyzing water basins, for dimensioning bridges, and for charting obstacles. The SPOT three dimensional products, levels, slopes, and block diagrams are particularly useful. ESA

N88-12158# Centre National d'Etudes Spatiales, Toulouse (France). Lab. d'Etudes et de Recherches en Teledetection Spatiale.
ADAPTATION OF NUMERICAL SPOT DATA TO AN URBAN ENVIRONMENT **c85**
Jacques Tournet, Jean Cussol, Catherine Pedron, Gilbert Saint, and Catherine Leprieur *In its* SPOT 1: First In-Flight Results 1987 p 121-126 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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Processing of SPOT images to provide urban engineers with a spectrally (decorrelation, resampling) and texturally (filtering) improved product is described. Objectives are the numerical analysis of such data incorporated into an urban data bank with an automatic extraction of specific data basically linked to the themes studied. ESA

N88-12159# Institut Geographique National, Paris (France).
CARTOGRAPHY AND TOPOGRAPHY WITH SPOT [CARTOGRAPHIE ET TOPOGRAPHIE AVEC SPOT]
Patrice Foin *In* CNES, SPOT 1: First In-Flight Results 1987 p 129-133 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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Production methods for topographic cartography using SPOT images are discussed. The definition of the data itself, and its thematic applications, such as using SPOT digital terrain models in geology and agronomy are considered. Altimetry (and its thematic applications), updating medium-scale maps, space-maps, and thematic cartography, especially related to land use, are reveiwed. ESA

N88-12160# Food and Agriculture Organization of the United Nations, Rome (Italy). Remote Sensing Center.
VEGETATION CLASSIFICATION, LAND SYSTEMS AND MAPPING USING SPOT MULTISPECTRAL DATA: PRELIMINARY RESULTS
J. A. Howard and D. Lantieri *In* CNES, SPOT 1: First In-Flight Results 1987 p 137-149 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Multispectral SPOT data covering 1800 sq km of Central Kenya were evaluated for vegetation classification, land systems, and mapping using a hierarchical approach to vegetation classification. The study of natural vegetation shows that major improvements can be obtained when the analysis is made within land systems easily delineated on SPOT imagery. Woody vegetation can be mapped in 3 broad height classes (forest greater than 20 m, woodland 5 to 20 m, shrubland less than 5 m) and 3 cover classes (closed, dense to open, sparse). Grasslands can be mapped in classes according to cover (dense, open) and habitat. Supervised digital classification provides better results than unsupervised classification. Study of agriculture shows that inside each land system, farming types can be mapped on SPOT imagery by field sizes (five classes), field density (three classes) and irrigated/nonirrigated land. Crop type mapping is improved when performed inside strata defined by farm size and density. Visual interpretation and mapping of forest plantations within a land system provide information on forest cover, stand height/density classes, and species. ESA

N88-12161# International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
SPOT FOR EARTHQUAKE HAZARD ZONING IN SOUTHERN ITALY, A PROVISIONAL REPORT **c46**
H. Th. Verstappen and R. J. Elsinga *In* CNES, SPOT 1: First In-Flight Results 1987 p 151-156 (For primary document see N88-12143 03-43)
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Earthquake hazard zoning is introduced using an area hit by an earthquake of magnitude 6.8 on the Richter scale as an example. The area is geologically complex and strongly influenced by neotectonics. Geomorphologically, it is characterized by considerable relief and widespread mass movements. The defined zoning in this area was compared with the percentage damage distribution of the earthquake and the zoning was extrapolated to a comparable area elsewhere. In addition to the (panchromatic) SPOT stereo images of both areas, LANDSAT images and aerial photographs (1:35,000 and 1:10,000) were used with the field survey. The SPOT data, because of their spatial resolution and stereoscopic capacity, are most useful; LANDSAT data provide insufficient detail and the aerial photographs lack a general overview. ESA

N88-12162# Centre National d'Etudes Spatiales, Toulouse (France).
FLOOD MONITORING USING SPOT
Damien Lepoutre *In* CNES, SPOT 1: First In-Flight Results 1987 p 159-164 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The expected availability of satellite images over the GHARB flood plains (Morocco) was studied during flood seasons using a Markovian cloud cover evolution model based on 20 yr data and simulations of the capabilities of satellites. One flood was studied using a SPOT HRV XS image. Valuable information is provided: overflow localization, flow path for the control of structures, soil erosion for the leveling process, and effectiveness of protection works. A map of submerged lands with associated figures for various management areas was produced, helping the decision making process in relation to production losses. Managers can compare the information to image expected availability, allowing them to decide whether to invest or not in satellite remote sensing technology for flood monitoring. The ability to quickly program SPOT is a decisive factor. ESA

N88-12163# Nevada Univ., Reno. Mackay School of Mines.
APPLICATION OF SPOT-1 DATA TO MINERAL EXPLORATION IN NEVADA **c46**
James V. Taranik and Marcus X. Borengasser *In* CNES, SPOT 1: First In-Flight Results 1987 p 167-172 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Use of SPOT multispectral and panchromatic data for mineral exploration was tested. Analysis suggests that photointerpretation of SPOT panchromatic data can be easily accomplished at 1:50,000 scale, or larger if desired, but not larger than 1:25,000 scale. Panchromatic data can be utilized for field investigations when enlarged to 1:12,000 scale. Multispectral data can be used for photointerpretation at 1:100,000 scale, or larger if desired, but not larger than 1:50,000 scale. Multispectral data can be utilized effectively for field investigations when enlarged to 1:25,000 scale. Multispectral data are comparable to LANDSAT TM multispectral data, but SPOT has better spatial resolution which aids in discriminating rock sequences. The TM 1.6 micron band adds significant spectral data for geological investigations and the combination of 1.6 and 2.2 micron bands allows important geological information on clays, carbonates, and sulfates associated with rock sequences. This information could be extracted from SPOT-4 data, although current plans do not include the 2.2 micron band. ESA

N88-12164# Paris VI Univ. (France).
GEOLOGICAL INTERPRETATION OF A SPOT IMAGE OVER KENYA: THE GREGORY RIFT NETWORK OF FAULTS **c46**
J. Chorowicz, G. Vidal, and J. P. Rudant *In* CNES, SPOT-1: First In-Flight Results 1987 p 173-179 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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A SPOT image of the East African Rift was processed. Standard processing (stretching, anamorphose, color composition) and specialized processing (smoothing, filtering, decorrelation) provide very high quality images. Lithology mapping and fault analysis are possible. The resulting map is compared with two maps of the same type, obtained from analyzing respectively LANDSAT MSS and TM images. The high spatial resolution of the SPOT data and their good radiometric quality allow the drawing of a far more precise map. The tension gashes are visible and the sinuous track of the faults perfectly exposed. This map permits study of the structure of this intersection zone of two large tectonic families: the submeridian faults belonging to the main rift trend, Cenozoic in age; the NW-SE faults belonging to the Aswa lineament zone, reactivating a Precambrian structure, having a transform character during the rift evolution. ESA

N88-12165# Bureau de Recherches Geologiques et Minieres, Minieres, Paris (France).
EVOLUTION OF REMOTE SENSING UTILIZATION IN GEOLOGICAL MAPPING AND ORE EXPLORATION: EXAMPLE IN ZIMBABWE **c46**
J. Y. Scanvic *In* CNES, SPOT 1: First In-Flight Results 1987 p 181-185 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The remote sensing survey of the Lomagundi (Zimbabwe) basin where copper and gold mineralizations are known, using SPOT is described. The copper metallotecte is disturbed by a complex tectonic which suggests difficulties for further exploitation. The proposed geological and structural mapping improves the knowledge of the metallotecte, making possible the discovery of new occurrences in the field. The discovery of a possible gold metallotecte along the Jaspe formations orients geochemical prospections. Adapted data processing enables mapping of specific ferruginous alterations. ESA

N88-12166# Centre National d'Etudes Spatiales, Toulouse (France). Lab. d'Etudes et de Recherches en Teledetection Spatiale.
VEGETATION STUDIES IN THE NATIONAL PARK OF COMOE (IVORY COAST) USING SPOT 1 SATELLITE DATA
F. Blasco, F. Lavenu, and G. Saint *In its* SPOT 1: First In-Flight Results 1987 p 189-195 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The capability of SPOT-1 to discriminate from space the woody fraction from the grass cover in areas where trees and shrubs are scattered was tested. The study of the panchromatic and multispectral modes offered the possibility to classify secondary vegetation types and to map them at scales of 1/50,000. ESA

N88-12167# Centre National de la Recherche Scientifique, Toulouse (France).
THE CONTRIBUTION OF SATELLITE DATA IN DRAWING UP MAPS USED IN RURAL DEVELOPMENT [L'APPORT DES DONNEES SATELLITAIRES DANS L'ETABLISSEMENT DES CARTES UTILISEES PAR LE DEVELOPPEMENT RURAL]
M. Bruneau and J. Kilian *In* CNES, SPOT 1: First In-Flight Results 1987 p 197-202 In FRENCH (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The use of satellite data to map rural land use in tropical regions is discussed. The physical and agricultural environments are considered. The physical milieu can be analyzed via a morphological map, derived from visual interpretation of aerial photographs and satellite imagery. The agricultural milieu is the greatest beneficiary of visual and numerical analysis of satellite data (particularly SPOT). ESA

N88-12168# Asian Inst. of Tech., Bangkok (Thailand).
A COMPARATIVE THEMATIC MAPPING ANALYSIS OF SPOT DATA: THE VIENTIANE PLAIN (LAOS)
D. Borel, Kaew Nualchaweek, and Phadej Savasdibutr (Mekong Committee Secretariat, Bangkok, Thailand) *In* CNES, SPOT 1: First In-Flight Results 1987 p 203-208 (For primary document see N88-12143 03-43)
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Thematic mapping of the 3500 sqkm Vientiane plain (Laos) a potential agricultural area, in terms of floods, soils, and topography is described. Photointerpretation of images at scale 1:30,000 allowed the production of maps at scale 1:100,000 in terms of geomorphology, morphopedology, land use/land cover, flood risk assessment, and agrosystems. The results are the reference data to test the possibility of using SPOT images to conduct the inventory of the natural environment and agricultural potentialities for this area. Results are encouraging. ESA

N88-12169# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPOT DATA FOR CROP DISCRIMINATION IN SOUTHERN BRAZIL
G. T. Batista, S. C. Chen, J. F. Dallemand, and A. T. Tardin *In* CNES, SPOT 1: First In-Flight Results 1987 p 209-222 (For primary document see N88-12143 03-43)
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Spatial resolution and spectral characteristics of SPOT HRV data for crop discrimination in Southern Brazil, taking into consideration the off-nadir viewing capability of SPOT were assessed using a test site having a variety of cover types during the winter growing season. Results using interactive image processing facilities show a systematic vertical noise especially noticeable in band 2 of SPOT occurring at a 7 pixel interval when both P and XS modes of 1 HRV were obtained simultaneously. The near infrared band presents the greatest information content in all satellite products analyzed compared with the visible bands. However, using a single band for crop discrimination, the chlorophyll absorption bands (band 2 for SPOT/HRV and band 3 for LANDSAT/TM) perform better than the near infrared band. It is

necessary to implement contextual analysis to benefit from the augmented spatial resolution of SPOT. ESA

N88-12170# Ministere de l'Agriculture (France).
SPOT: A TOOL FOR AGRICULTURAL STATISTICS [SPOT: UN OUTIL POUR LES STATISTIQUES AGRICOLES]
J. Meyer-Roux, Ph. Fournier, and R. Pastorelli *In* CNES, SPOT 1: First In-Flight Results 1987 p 225-233 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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Use of SPOT satellite data to get or improve agricultural statistics by constructing an areaframe sampling, automated classification to get crop acreages, and extracting the yield component for crop prediction, was studied. The delays in the distribution are sufficient for the first two objectives, not for the third one. The quality control of the data suggests that SPOT images are well suited for areaframes since most physical boundaries on the ground can be recognized on images and vice-versa. Equalization of the data of twin images must be made before doing an automated classification covering both of them. ESA

N88-12171# Institut National de la Recherche Agronomique, Thiverval-Grignon (France).
APPLICATION OF MULTITEMPORAL SPOT DATA FOR CROP MONITORING: EFFECTS OF FROST AND DROUGHT [APPLICATIONS DES DONNEES MULTIDATES SPOT A LA SURVEILLANCE DES CULTURES: EFFETS DU GEL ET DE LA SECHERESSE]
P. Boissard, J. G. Pointel, J. P. Moreau, and G. Rivet *In* CNES, SPOT 1: First In-Flight Results 1987 p 235-244 In FRENCH (For primary document see N88-12143 03-43)
(Contracts PEPS-80; CNES-ATP-1985)
Copyright Avail: CEPADUES-Editions, Toulouse, France

Crop monitoring by SPOT in unusual weather conditions is described. Climatic conditions of 1986 in Ile-de-France region are different from normal conditions based on 40 yr averaging, because of strong frost during February followed by hydric deficit. These meteorological data are responsible for cereal field decrease (10 to 20 q/ha). Three SPOT scenes were analyzed: one at the end of cold conditions, two during the hotest period. The results show how SPOT allows frost injuries description in relation to final yield. Crop response to hydric stress is monitored using a vegetation index variation within a 5 day period. ESA

N88-12172# Ministere de l'Energie et des Ressources (Quebec). Centre de Coordination de la Teledetection.
USE OF SPOT PANCHROMATIC IMAGERY TO UPDATE FOREST MAPS OF NORTHERN QUEBEC, CANADA [UTILISATION DE L'IMAGE SPOT PANCHROMATIQUE DANS LA MISE A JOUR DES CARTES FORESTIERES DU QUEBEC BOREAL, CANADA]
Maurice Carignan, Chantal Seuthe, and Jean-Pierre Letourneau *In* CNES, SPOT 1: First In-Flight Results 1987 p 247-252 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

The use of a SPOT panchromatic image to update forest cut-overs on 1:20 000 maps was studied. In the boreal forest, the SPOT picture could replace conventional aerial photographs to clearly delineate clear and strip cuts and the remaining forested patches. The area differences computed from both sources of information are less than 5 percent. However, it is anticipated that high costs and long delays in acquiring SPOT images will limit, in the short term, their widespread use. ESA

N88-12173# Technical Research Centre of Finland, Espoo.
STAND BASED FOREST INVENTORY FROM SPOT IMAGE. FIRST EXPERIMENTS
Tuomas Haeme and Erkki Tomppo *In* CNES, SPOT 1: First In-Flight Results 1987 p 253-258 (For primary document see N88-12143 03-43)
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A stand-based forest inventory method where the preliminary inventory result for the forest management plan is obtained with numerical interpretation of SPOT satellite images (and/or LANDSAT TM images) is considered. Stand delineation and stand variates estimation, as well as change detection are studied. The basic ground truth data are field-measured systemic sample plots of a national forest survey. The visible channels are nearly similar, but SPOT includes more spatial information than LANDSAT TM images. The interpretation of SPOT images requires spatial interpretation methods. Stand delineation with SPOT image segmentation shows differences when compared to corresponding segmentation from LANDSAT TM. Visual products made from SPOT images can partially replace aerial photographs. ESA

N88-12174# Sveriges Lantbruksuniv., Umea. Remote Sensing Lab.
APPLICABILITY OF SPOT FOR FOREST INVENTORY, MAPPING AND CHANGE MONITORING
S. Jaakkola, L. Johansson, and O. Hagner *In* CNES, SPOT 1: First In-Flight Results 1987 p 259-264 (For primary document see N88-12143 03-43)
(Contract PEPS-Proj-155)
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Use of digital SPOT satellite imagery for forest inventory was studied on a test site in northern Sweden. The original image data was matched (PA+XS), corrected geometrically, and resampled to 10 m. Filtering algorithms were developed and/or applied for detection of logging roads and timber stand boundaries. Timber stand mapping was made using three methods derived from the maximum likelihood rule. Change monitoring was tried by interpreting a single date SPOT image and a year-old CIR aerial photo. All logging roads could be mapped; 88 percent of new clear cuts are found; and 95 percent and 87 percent of timber stands, with 6 and 9 classes, respectively, are correctly classified. The segment timber stand mapping approach developed gives the best results considering visual impression, the overall performance tested, and the boundary analysis made. ESA

N88-12175# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
USE OF SPOT IMAGES FOR COASTAL DEVELOPMENT AND INVENTORY OF AQUACULTURAL SITES IN NEW CALEDONIA (ALIAS PROJECT). FIRST RESULTS [UTILISATION DES IMAGES SPOT POUR L'AMENAGEMENT LITTORAL ET L'INVENTAIRE DES SITES AQUACOLES EN NOUVELLE CALEDONIE (PROJECT ALIAS). RESULTATS PRELIMINAIRES] **c48**
L. Loubersac, A. Grotte, and M. Viollier *In* CNES, SPOT 1: First In-Flight Results 1987 p 267-273 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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The use of level 2 multispectral SPOT data for the inventory of tropical shrimp aquaculture sites is presented. Results based on spectroradiometric measurements on the validation of a methodology are exposed. A preliminary form of products is proposed. ESA

N88-12176# Societe Europeenne de Propulsion, Puteaux (France). Image Processing Div.
CONTRIBUTION OF SPOT DATA TO THE PHYSIOGRAPHIC STUDY OF COASTAL ENVIRONMENT: LA POINTE D'ARCAY AND L'ANSE DE L'AIGUILLON (FRANCE) **c48**
Philippe Rebillard and Fernand Verger (Centre National de la Recherche Scientifique, Paris, France) *In* CNES, SPOT 1: First In-Flight Results 1987 p 275-280 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
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Data from SPOT for two coastal environment of fast evolution were coregistered to LANDSAT MSS, TM, SAR data. The comparison of the coregistered data set brings new thematic information related to the coastal environment. ESA

N88-12177# Dakar Univ. (Senegal). Inst. Fondamental d'Afrique Noire.
COASTAL DYNAMICS OF THE MOUTH OF THE SALOUM (SENEGAL) [LA DYNAMIQUE LITTORALE A L'EMBOUCHE DU SALOUM (SENEGAL)] **c48**
Amadou Tairou Diaw and Yves-Francois Thomas (Ecole Normale Superieure, Paris, France) *In* CNES, SPOT 1: First In-Flight Results 1987 p 281-283 In FRENCH (For primary document see N88-12143 03-43)
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Multispectral SPOT imagery was used to study a littoral characterized by a complicated hydrology involving high salinity, slowly flowing river, constantly moving sandbanks, and extremely mobile subtidal channels. The interactions of depth, turbidity, and the nature of the bottom often limit classifications from multiband data. However, spectral bands taken individually allow phenomena to be distinguished (e.g., suspensions, erosion, and swell). ESA

N88-12178# Centre National d'Etudes Spatiales, Toulouse (France). Sous-Direction Applications.
THE NEW GENERATION OF SPOT SATELLITES [LA NOUVELLE GENERATION DES SATELLITES SPOT] **c18**
Michel Courtois *In its* SPOT 1: First In-Flight Results 1987 p 287-291 In FRENCH (For primary document see N88-12143 03-43)
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The instrumentation, missions, observation program, and geometric image characteristics of the SPOT satellites 2 to 5 are described. The main differences compared to SPOT 1 concern an instrument for global vegetation monotoring and one for mid IR observation at 1.6 and 2.0 microns. ESA

N88-12179# International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
THE USE OF SPOT IMAGES FOR WATER RESOURCES SURVEYS. THE EXAMPLES OF THE KASSERINE AREA (TUNISIA) AND THE JEBEL AMOUR (ALGERIA)
Dirk deHoop, Atila Sesoren, and Caesar Voute *In* CNES, SPOT 1: First In-Flight Results 1987 p 293-304 (For primary document see N88-12143 03-43)
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Use of SPOT images to survey water resources in data rich and data sparse semi arid regions is described. One area has surface water and ground water, the other mainly surface runoff. The SPOT images are useful for mapping geological features, vegetation, land use, drainage patterns, catchment areas, and archeological traces. ESA

N88-12180# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Fernerkundung.
EVALUATION OF DIGITAL, MULTITEMPORAL LANDSAT 5 THEMATIC MAPPER DATA FOR THE DETERMINATION OF THE AERIAL SNOWCOVER EXTENT AND SPECTRAL SEPARATION OF VARIOUS SURFACE TYPES IN THE INNER OETZTAL (WEST GERMANY) WITH SPECIAL REGARD TO THE SIGNIFICANCE OF AERIAL SNOWCOVER INFORMATION FOR WATER RESOURCES MANAGEMENT Thesis - Ludwig-Maximilians-Univ.
Ute Guck Oct. 1986 170 p In GERMAN; ENGLISH summary (DFVLR-FB-86-46; ISSN-0171-1342; ETN-87-90593) Avail: NTIS HC A08/MF A01; DFVLR, Cologne, West Germany DM 74.50

The spectral behavior of snow in high mountain reliefs, measured by the LANDSAT thematic mapper (TM) at several times, was investigated. The aerial snowcover extent was determined using the supervised maximum likelihood classification. Contrast stretching and ratioing were performed for easier visual interpretation. Histograms and principal component analysis were used for statistical evaluation. The potential of TM bands to separate clouds from snow and for a multispectral classification of the major vegetation types is demonstrated. The combination of bands 2, 3, 4, and 5 proves to be sufficient for all classifications. While the spectral bands of the TM are suited for snow type discrimination, problems arise for radiometric resolution due to dynamic range limitations. ESA

N88-12181# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Optische Fernerkundung.
THE DISTINCTION BETWEEN DIFFERENT WATER MASSES USING OPTICAL REMOTE SENSING APPLIED TO DATA FROM THE ALBORAN SEA EXPERIMENT 1982 Thesis - Trier Univ.
Klaus W. Barrot, Heinz vanderPiepen, and Volker Amann Oct. 1986 68 p In GERMAN; ENGLISH summary (DFVLR-FB-86-48; ISSN-0171-1342; ETN-87-90594) Avail: NTIS HC A04/MF A01; DFVLR, Cologne, West Germany DM 25

Data sets from different remote sensing instruments were used to monitor the in flow of Atlantic water through the Straits of Gibraltar into the western Mediterranean Sea. Besides the data from the Advanced Very High Resolution Radiometer and the NOAA8 satellite, those from the Coastal Zone Color Scanner on Nimbus 7 were used to measure and interpret ocean color, and to compare the results with data collected from airborne radiometry and shipborne ground truth. It is concluded that dynamic processes in the sea can often be monitored and interpreted better using ocean color rather than sea surface temperature. ESA

N88-12182# Kernforschungszentrum, Karlsruhe (West Germany).
DEVELOPMENT OF A METHOD FOR FOREST DAMAGE INVENTORY USING MULTISPECTRAL SCANNER DATA
G. Hildebrandt, A. Kadro, S. Kuntz, and C. Kim (Freiburg Univ., West Germany) Mar. 1987 105 p In GERMAN; ENGLISH summary Original contains color illustrations
(Contract PEF-83/001/EG)
(KfK-PEF-25; ISSN-0931-2749; ETN-87-91033) Copyright Avail: NTIS HC A06/MF A01

Spectral reflection properties of forest vegetation, especially the difference between healthy and damaged trees and stands, was investigated, based on the evaluation of multispectral scanner data in the visual, near IR, and middle IR. Data were collected from different flight altitudes. A computer aided classification for forest stand damage inventory is discussed. ESA

N88-12183# International Bank for Reconstruction and Development, Washington, D.C.
DESERTIFICATION IN THE SAHELIAN AND SUDANIAN ZONES OF WEST AFRICA
J. E. Gorse and D. R. Steeds 1987 77 p
(PB87-217063; WORLD BANK/TP-61; ISBN-0-8213-0897-1; LC-87-16131) Copyright Avail: NTIS MF A01; HC available from World Bank, 1818 H Street, N.W., Washington, D.C. 20433 CSCL 08B

Desertification is defined as the sustained decline of the biological productivity of arid and semi-arid land. It is the results of pressures both human (increased population) and climatic (variable rainfall and long-term changes in climate). Three traditional production systems exist in the Sahelian and Sudanian Zones (SSZ): agrosylvicultural, and sylvopastoral. Development activities were tried in the past in the agriculture, livestock, and forestry sectors. Strategies for better resource management depend on the balance between the rural population and the carrying capacity of the land. Such strategies include increasing research on production systems, training staff and farmers, reducing the population through child spacing and resettlement, increasing the stock of fuelwood, reforming land laws, and providing incentives for increased agricultural and forestry production. GRA

N88-12184# Geological Survey, Denver, Colo.
A WORKSHOP ON DESERT PROCESSES, SEPTEMBER 24-28, 1984: REPORT ON THE CONFERENCE
John F. McCauley and Jack N. Rinker 1987 25 p Workshop held in Flagstaff, Ariz.

(AD-A184599; USGS-CIRC-989) Avail: NTIS HC A03/MF A01 CSCL 08F

At present, the United States Geological Survey is monitoring geometeorological conditions in different types of deserts in Arizona, using data relayed by satellite from solar-powered Geomet stations. These stations consist of automated data-collection platforms coupled with an array of sensors that measure boundary-layer atmospheric and geologic conditions at frequent intervals, around the clock. Such data are essential to studies of surface geologic processes in deserts, particularly wind erosion, and of the landforms that develop in response to these processes. The Geomet data are also of interest to the U.S. Army, which must operate in various types of deserts and therefore needs information related to natural hindrances to cross-country movement, selection of aircraft landing sites, cover and concealment, camouflage, dust generation, and location of usable water. The U.S. Army Engineer Topographic Laboratories, Center for Remote Sensing (ETL-CRS), has evaluated a variety of remote sensors and image-analysis techniques in subhumid regions, and a part of its research program is directed toward applying these techniques to the Army's need for information on desert terrain. The complementary research needs of the USGS and ETL-CRS resulted in a workshop held in Flagstaff, Ariz., on September 24 to 28, 1984. GRA

N88-12185*# California Univ., Santa Barbara. Dept. of Geography.
THE CORRESPONDENCE OF SURFACE CLIMATE PARAMETERS WITH SATELLITE AND TERRAIN DATA Semiannual Report
Jeff Dozier and Frank Davis 14 Dec. 1987 14 p
(Grant NAG5-917)
(NASA-CR-181515; NAS 1.26:181515) Avail: NTIS HC A03/MF A01 CSCL 08B

One of the goals of the research was to develop a ground sampling stragegy for calibrating remotely sensed measurements of surface climate parameters. The initial sampling strategy involved the stratification of the terrain based on important ancillary surface variables such as slope, exposure, insolation, geology, drainage, fire history, etc. For a spatially heterogeneous population, sampling error is reduced and efficiency increased by stratification of the landscape into more homogeneous sub-areas and by employing periodic random spacing of samples. These concepts were applied in the initial stratification of the study site for the purpose of locating and allocating instrumentation. Author

N88-12186# Army Engineer Topographic Labs., Fort Belvoir, Va.
A REVIEW OF COMPUTER-ASSISTED PHOTO INTERPRETATION RESEARCH AT USAETL (US ARMY ENGINEER TOPOGRAPHIC LABORATORIES)
George E. Lukes 16 Jan. 1987 6 p
(AD-A184034; ETL-R100) Avail: NTIS HC A02/MF A01 CSCL 08B

A program in computer-assisted photo interpretation research (CAPIR) was initiated at the U.S. Army Engineer Topographic Laboratories (USAETL) in 1979. The primary objective was to develop and implement concepts to increase the productivity of the human photo interpreter tasked with extracting terrain data from aerial imagery. Early efforts focused on implementation of interactive software for direct capture of digital map data from stereo mapping and reconnaissance photography. The development of a hardcopy stereo workstation with integral computer graphic superposition has been essential to provide a suitable interactive, closed-loop environment for the photo interpreter. This paper provides a brief introduction to the problem domain of terrain analysis and outlines the evolution of the CAPIR program emphasizing the special requirements for an effective man-machine interface. The application of current CAPIR technology to typical terrain data capture problems is discussed with selected examples of technology transfer and examples of new commercial photogrammetric instrumentation incorporating graphic superposition capabilities. Opportunities to extend CAPIR concepts to softcopy terrain analysis based on adaptation of digital image processing technology are then presented. Digital image source materials and potential softcopy processing advantages are discussed and key requirements for effective softcopy terrain analysis are summarized. GRA

N88-12187# Massachusetts Inst. of Tech., Cambridge.
RESEARCH IN GEODESY BASED UPON RADIO INTERFEROMETRIC OBSERVATIONS OF GPS (GLOBAL POSITIONING SYSTEM) SATELLITES Final Report, 5 Feb. 1982 - 31 Dec. 1985
Charles C. Counselman, III 31 Dec. 1986 18 p
(Contract F19628-82-K-0002)
(AD-A184040; AFGL-TR-87-0091) Avail: NTIS HC A03/MF A01 CSCL 08E

MIT explored and extended the capabilities of the new technique of geodesy by radio interferometry using signals from the NAVSTAR Global Positioning System (GPS) satellites. Accuracy in the determination of long relative-position, or baseline, vectors between fixed points on the earth was improved by the use of doubly differenced, dual frequency (L1 and L2 band). Carrier phase observations, and by determining the orbits of the satellites from observations at widely spaced sites whose relative positions were well known a priori from quasar observations. Accuracy of about 1 part in 10 million of the length of a long baseline, and 1 millimeter for a short baseline, was achieved. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-12188*# National Aeronautics and Space Administration, Washington, D.C.
ELECTRICITY FROM PHOTOVOLTAIC SOLAR CELLS. FLAT-PLATE SOLAR ARRAY PROJECT OF THE US DEPARTMENT OF ENERGY'S NATIONAL PHOTOVOLTAICS PROGRAM: 10 YEARS OF PROGRESS
Elmer Christensen Oct. 1985 105 p Prepared in cooperation with JPL, Pasadena, Calif. and DOE, Washington, D.C.
(NASA-TM-89653; NAS 1.15:89653) Avail: NTIS HC A06/MF A01 CSCL 10A

The objectives were to develop the flat-plate photovoltaic (PV) array technologies required for large-scale terrestrial use late in the 1980s and in the 1990s; advance crystalline silicon PV technologies; develop the technologies required to convert thin-film PV research results into viable module and array technology; and to stimulate transfer of knowledge of advanced PV materials, solar cells, modules, and arrays to the PV community. Progress reached on attaining these goals, along with future recommendations are discussed. B.G.

N88-12189# Sandia National Labs., Albuquerque, N. Mex.
APPLICATION OF SOLAR TECHNOLOGY TO FUEL PRODUCTION CHEMICAL PROCESSING, AND THERMOCHEMICAL ENERGY TRANSPORT: STATUS AND FUTURE
J. D. Fish 1987 13 p Presented at the International Solar Energy Society International Congress on Solar Energy, Hamburg, Fed. Republic of Germany, 13 Sep. 1987
(Contract DE-AC04-76DP-00789)
(DE87-014172; SAND-87-1241C; CONF-870903-1) Avail: NTIS HC A03/MF A01

The status of investigations into the application of solar thermal technology to fuel production, chemical processes, and thermochemical energy transport and storage in several countries around the world is discussed. In addition, the concept of a direct

catalytic absorption receiver (DCAR) and the potential role this concept may play in the future of solar fuels and chemicals are presented. DOE

N88-12190# Sandia National Labs., Albuquerque, N. Mex.
MECHANICALLY STACKED MULTIJUNCTION SOLAR CELLS: AN UPDATE ON SANDIA PROGRAMS
J. M. Gee and D. L. King 1987 5 p Presented at the 3rd International Photovoltaic Science and Engineering Conference, Tokyo, Japan, 3 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE87-014641; SAND-87-2184C; CONF-871112-2) Avail: NTIS HC A02/MF A01

Recent progress in a program managed by Sandia National Laboratories for development of mechanically stacked, multijunction (MSMJ) solar cells is reported. The goal of the program is to develop a 2-junction, 4-terminal tandem concentrator cell with an efficiency of 30%. Two MSMJ cells are under development. The first MSMJ cell consists of a wide-bandgap cell stacked on top of a silicon solar cell. The second MSMJ cell consists of a GaAs cell stacked on top of a narrow-bandgap solar cell. The best MSMJ cell demonstrated to date is a GaAs/silicon MSMJ concentrator cell that achieved an efficiency of 26.6% at 100 suns. DOE

N88-12191# AV-YO, Inc., Kaneohe, Hawaii.
BUILD, INSTALL AND DEMONSTRATE A VARIABLE STROKE PUMP CONTROL AND WINDMILL SYSTEM Quarterly Technical Progress Report No. 5
D. E. Avery 15 Sep. 1987 93 p
(Contract DE-FG01-86CE-15279)
(DE87-014656; DOE/CE-15279/T5) Avail: NTIS HC A05/MF A01

This report consists of two sets of working drawings for a 14 foot wind-powered pumping system. The drawings are of the variable strike mechanism (VSM) and of the new gear drive (NGD). DOE

N88-12192# Stuttgart Univ. (West Germany). Fakultaet fuer Luft- und Raumfahrt.
LINEARIZED AEROELASTIC ANALYSIS OF A WIND TURBINE WITH A TWO-BLADED ROTOR Ph.D. Thesis [LINEARISIERTE AEROELASTISCHE ANALYSE EINER WINDTURBINE MIT ZWEIBLATTROTOR]
Bertold Kirchgaessner 1986 190 p In GERMAN
(ETN-87-90600) Avail: NTIS HC A09/MF A01

The coupled, linearized system tower-rotor of a wind turbine with horizontal axis and asymmetric rotor was investigated. The equations of motion of the linearized system were deduced. The displacements of tower and rotor are described. Linearized, quasistationary aerodynamic loads were taken into account. The structure and modal analysis of the isolated partial systems are described using finite element program systems. The stability of the system of equations of motion was determined by Floquet theory. The frequency spectra of the eigenvibrations of the periodic system were obtained. The dynamic response of the system to periodic and generally time-dependent excitations was deduced. ESA

N88-12193# European Space Agency, Paris (France).
NUMERICAL AND EXPERIMENTAL INVESTIGATION OF THE UNSTEADY TEMPERATURE DISTRIBUTION IN SOLAR CENTRAL RECEIVERS
Gerold Lemperle Jun. 1987 130 p Transl. into ENGLISH of Numerische und Experimentelle Untersuchung der Instationaeren Temperaturverteilung in Strahlungsabsorberrohren (Stuttgart, Fed. Republic of Germany, DFVLR), Oct. 1986 Original language document was announced as N87-26407
(ESA-TT-1050; DFVLR-FB-86-43; ETN-87-90872) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 37.50

A finite difference scheme for the calculation of the unsteady temperature distribution in irradiated tubes of a solar central receiver was developed. The computation code is based on the radiation exchange in the visible and IR wavelength range, and on the energy balances for tube wall, heat carrier, and ceramic back wall. The front surface temperature of a sodium-coded receiver was measured by a thermovision device. The measured temperatures show good agreement with the calculated values, and were used to determine heat losses and efficiency. ESA

N88-12194# Atlanta Univ., Ga. Dept. of Chemistry.
METAL CONTAINING POLYMERS AS FUEL CELL CATALYSTS Final Report, 27 Sep. 1982 - 26 Jun. 1986
James L. Reed 30 Jun. 1987 64 p
(Grant DAAG29-82-G-0015)
(AD-A184605; ARO-19924.1-CH-H) Avail: NTIS HC A04/MF A01 CSCL 10C

Several aspects of the fuel cell problem were addressed in this investigation. The objective of this work was the development of a fuel cell electrode-catalyst for use in a carbon monoxide fuel cell, which would utilize polymer bound metal complexes as the catalytic species. Several commercially available polymers were examined to be used as backbones in the development of an electrode-catalyst. Polystyrene was chosen for more extensive study. The polymer was activated by complete or partial monochloromethylation of the pendant phenyls. Several schemes for binding cyclic tetradentate and bidentate ligands to the activated polymers were not obtained. The transition metals cobalt and nickel were incorporated into the polymers, and these new materials were examined. In addition, the electrochemical behavior of several metal complexes which hold potential as catalytic species was examined. GRA

N88-12195# Southern California Edison Co., Rosemead.
DYNAMIC RESPONSE OF A 330 KW HORIZONTAL AXIS WIND TURBINE GENERATOR
I. Redmond, C. G. Anderson, and P. Jamieson 29 Jun. 1987 136 p
(Contract DE-FC02-85CH-10249)
(DE87-014867; DOE/CH-10249/T1) Avail: NTIS HC A07/MF A01

This report is the result of a combined experimental and theoretical study of the dynamic response of a Howden HWR 330/26 wind turbine generator. The work was undertaken with the main aim of extending the knowledge of dynamic loading of wind turbines. DOE

N88-12196# Polytechnic Univ., Brooklyn, N.Y. Dept. of Chemical Engineering.
HEATS OF MIXING FOR THERMAL ENERGY STORAGE SYSTEMS. PHASE 1: SELECTION OF SUITABLE LIQUID-LIQUID MIXTURES
L. I. Stiel Jul. 1987 51 p Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract DE-AC05-84OR-21400)
(DE87-014971; ORNL/Sub-86-27470/1) Avail: NTIS HC A04/MF A01

A research program is being conducted on the use of liquid-liquid systems for thermal energy storage applications. The results of Phase I of this study, involving the identification of potential binary aqueous systems for further experimental study, are summarized in this report. Analytical procedures are described for the estimation of heats of mixing of liquid-liquid systems from phase equilibrium data. These procedures have been utilized to determine heat and cool storage capabilities of a number of mixtures. It have found that aqueous systems with lower critical solution temperatures in a suitable range can result in a large increase in the effective heat capacity in the critical region. DOE

N88-12197# Lappeenrannan Teknillinen, Korkeakoulu (Finaland). Energiatekniikan Laitos.
APPLICATION OF ORGANIC RANKINE CYCLES (ORCs) TO DECENTRALIZED POWER GENERATION, PRELIMINARY STUDY
Reino Huovilainen, Jarmo Alamaeki, and Risto Tarjanne 1987

135 p In FINNISH
(DE87-753331; LTKK-EN-C-42) Avail: NTIS (US Sales Only)
HC A07/MF A01

The study concentrates on MW-class ORC processes that could be utilized in connection with different kind of power plants. The use of an ORC-process may offer potential for improvements in two ways; first, an ORC-process can be suitable with low-grade thermal sources where water based power generation is not feasible. Second, an increase in power generation efficiency is achieved. The connection of an ORC-process to following plants were investigated; a gas burning heat-only boiler, a solid fuel boiler, a steam and gas turbine (co-generation) unit, a steam turbine and a heating reactor. In each case the following economical factors for adding an ORC-process were calculated; the cost for electricity, the return of investment (ROI) and the pay-back period. The most favorable cases to utilize an ORC-process are a heating reactor, a steam turbine and a gas turbine based co-generation plant. In connection with heat-only plants a better economy were achieved than with co-generation plants. The results indicate that there can be found economically promising applications for ORC-processes in industry and power plants. It is evident that those cases should be investigated more in detail. ORC-processes allow power generation in new circumstances and can increase the efficiency of power plants. More emphasis should be paid for the R and D of this relatively new technology. DOE

N88-12198# Army Military Personnel Center, Alexandria, Va.
DESIGN OF A CONDENSER-BOILER FOR A BINARY MERCURY-ORGANIC RANKINE CYCLE SOLAR DYNAMIC SPACE POWER SYSTEM Final Report
Randy M. Cotton 15 May 1987 90 p
(AD-A184188) Avail: NTIS HC A05/MF A01 CSCL 10B

A theoretical design was performed for the condenser/boiler of a space-based solar dynamic power system. The base system is a binary Rankine cycle with mercury and toluene as the working fluids. System output is 75 KWe with a combined efficiency of 41.1%. Design goals were to develop the most reliable, mass efficient unit possible for delivery to a space station. The design sized the unit based on toluene properties and used a computer generated heat balance to thermodynamically match the two fluids. Molybdenum was chosen as the material due to mass effectiveness in heat transfer, strength, and resistance to mercury corrosion. The unit transferred 137.46 kilowatts of thermal power and can operate at varying mass flow rates. Effectiveness in heat transfer is 0.96 and mass performance is 0.016 kg/KWth transferred. The design depends on using only existing technologies and the results call for no new developments. GRA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-12199# Committee on Commerce, Science, and Transportation (U.S. Senate).
GLOBAL ENVIRONMENTAL CHANGE RESEARCH
Washington GPO 1987 156 p Hearing before the Subcommittee on Science, Technology and Space and the National Ocean Policy Study of the Committee on Commerce, Science and Transportation, 100th Congress, 1st Session, 16 Jul. 1987
(S-Hrg-100-301; GPO-77-482) Avail: Subcommittee on Science, Technology and Space

Testimony of various government and university scientists, including a representative of NASA, before the subcommittee is presented. The status of research on manmade environmental changes is reported with the goal of informing national research policy in this area. J.P.B.

N88-12200# Argonne National Lab., Ill.
COMPARISON OF THREE AEROSOL SAMPLING TECHNIQUES AND THE DIFFERENCES IN THE NITRATE DETERMINED BY EACH
S. A. Johnson and R. Kumar 1987 7 p Presented at the EPA/APCA Symposium on Measurement of Toxic and Related Air Pollutants, Research Triangle Park, N.C., 3 May 1987
(Contract W-31109-eng-38)
(DE87-011456; CONF-8705149-1) Avail: NTIS HC A02/MF A01

Ambient aerosol samples were collected simultaneously with three different methods, one a size fractionated impactor sampler and two filter samplers. Infrared spectroscopy was used to analyze the collected aerosol using attenuated total internal reflection for the impactor samples and direct transmission through ultra-thin teflon membrane filters for the filter samples. All samples were analyzed as soon as possible after collection; some were reanalyzed after being stored in closed petri dishes for up to 10 days. A major purpose of the study was to evaluate the neutralization of acidic sulfate aerosols after sample collection by the filtration techniques. No acidic sulfate was found in any of the samples collected during the field study. However, significant differences were observed in the nitrate content of the samples collected by the different samplers. Also, in several samples collected with the ATR impactor the nitrate content decreased upon storage. In some cases the nitrate absorbance bands diminished to zero; in other cases the nitrate initially decreased and then remained stable; in yet another case, a high level of nitrate persisted over several days. The results indicate that two different types of nitrate compounds were present in the samples, one more volatile than the other, although the infrared spectra were consistent with both of them being ammonium nitrate. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-12201# National Oceanic and Atmospheric Administration, Boulder, Colo. World Data Center A for Solid Earth Geophysics.
DIRECTORY OF GEOMAGNETIC OBSERVATORIES WITH HIGH-RESOLUTION DIGITAL RESULTS, 1987
K. L. Svendsen, S. J. McLean, and W. V. Flanagan Jul. 1987 73 p
(PB87-221156; SE-43) Avail: NTIS HC A04/MF A01 CSCL 08G

Digital magnetometers descriptions, recorded data, estimates of baseline drift rates, availability of machine-readable digital data, observatory lists, processing steps, and observatories with facilities for digitizing are presented in tabular form. B.G.

N88-12202# IIT Research Inst., Bartlesville, Okla.
GEOLOGICAL CHARACTERIZATION AND STATISTICAL COMPARISON OF OUTCROP AND SUBSURFACE FACIES: SHANNON SHELF SAND RIDGES
S. Jackson, M. Szpaklewicz, and L. Tomutsa Sep. 1987 64 p
(Contract DE-FC22-83FE-60149)
(DE87-001243; NIPER-214) Avail: NTIS HC A04/MF A01

The primary objective of this research is to develop a methodology for constructing accurate quantitative models of reservoir heterogeneities. The resulting models are expected to improve predictions of flow patterns, spatial distribution of residual oil after secondary and tertiary recovery operations, and ultimate oil recovery. The purpose of this study is to provide preliminary evaluation of the usefulness of outcrop information in characterizing analogous reservoirs and to develop research techniques necessary for model development. The Shannon Sandstone, a shelf sand ridge deposit in the Powder River Basin, Wyoming, was studied. Sedimentologic and petrophysical features of an outcrop exposure of the High-Energy Ridge-Margin facies (HERM) within the Shannon were compared with those from a Shannon sandstone reservoir in Teapot Dome field. Comparisons of outcrop and subsurface permeability and porosity histograms, cumulative

distribution functions, correlation lengths and natural logarithm of permeability versus porosity plots indicate a strong similarity between Shannon outcrop and Teapot Dome HERM facies petrophysical properties. Permeability classes found in outcrop samples can be related to crossbedded zones and shaley, rippled, and bioturbated zones. Similar permeability classes related to similar sedimentologic features were found in Teapot Dome field. The similarities of outcrop and Teapot Dome petrophysical properties, which are from the same geologic facies but from different depositional episodes, suggest that rocks deposited under similar depositional processes within a given deposystem have similar reservoir properties. The results of the study indicate that the use of quantitative outcrop information in characterizing reservoirs may provide a significant improvement in reservoir characterization. DOE

N88-12203*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
AN ALGORITHMIC APPROACH TO CRUSTAL DEFORMATION ANALYSIS
Huseyin Baki Iz Oct. 1987 128 p
(Grant NsG5-265)
(NASA-CR-181497; NAS 1.26:181497; Rept-382) Avail: NTIS HC A07/MF A01 CSCL 08G

In recent years the analysis of crustal deformation measurements has become important as a result of current improvements in geodetic methods and an increasing amount of theoretical and observational data provided by several earth sciences. A first-generation data analysis algorithm which combines a priori information with current geodetic measurements was proposed. Relevant methods which can be used in the algorithm were discussed. Prior information is the unifying feature of this algorithm. Some of the problems which may arise through the use of a priori information in the analysis were indicated and preventive measures were demonstrated. The first step in the algorithm is the optimal design of deformation networks. The second step in the algorithm identifies the descriptive model of the deformation field. The final step in the algorithm is the improved estimation of deformation parameters. Although deformation parameters are estimated in the process of model discrimination, they can further be improved by the use of a priori information about them. According to the proposed algorithm this information must first be tested against the estimates calculated using the sample data only. Null-hypothesis testing procedures were developed for this purpose. Six different estimators which employ a priori information were examined. Emphasis was put on the case when the prior information is wrong and analytical expressions for possible improvements under incompatible prior information were derived. Author

N88-12204# Midwest Research Inst., Golden, Colo.
A QUASI-PHYSICAL MODEL FOR CONVERTING HOURLY GLOBAL HORIZONTAL TO DIRECT NORMAL INSOLATION
E. L. Maxwell Aug. 1987 67 p
(Contract DE-AC02-83CH-10093)
(DE87-012273; SERI/TR-215-3087) Avail: NTIS HC A04/MF A01

Numerous research studies have shown that the use of a single regression function does not adequately characterize the relationship between direct beam transmittance (Kn) and the effective global horizontal transmittance (Kt). Therefore, the Direct Insolation Simulation Code (DISC) employs an exponential relationship betweenKn and air mass which is parametric in Kt. This algorithm seems to provide a satisfactory Kn-Kt relationship for a wide range of stations and seasons. Validation of the DISC Model was accomplished with data from three widely separated stations (Albuquerque, Bismarck, and Brownsville) which were not used for model development. Comparisons with the ETMY model (used to generate direct normal data for 222 of the 248 stations in the national data base) showed substantial improvements in the accuracy of hourly values, significant reductions in monthly RMS errors, and equivalent monthly mean bias errors. Furthermore, modification of the DISC model to incorporate cloud-cover, water vapor, and albedo terms appears to be straightforward. DOE

N88-12205*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
THE INTERPRETATION OF CRUSTAL DYNAMICS DATA IN TERMS OF PLATE MOTIONS AND REGIONAL DEFORMATION NEAR PLATE BOUNDARIES Semiannual Status Report No. 2, 22 Mar. - 21 Sep. 1987
Sean C. Solomon 20 Nov. 1987 126 p
(Grant NAG5-814)
(NASA-CR-181475; NAS 1.26:181475) Avail: NTIS HC A07/MF A01 CSCL 08G

The focus of the research was in two broad areas during the most recent 6 month period: the nature and dynamics of time-dependent deformation along major seismic zones, including the influence of irregularities in fault geometry on the earthquake cycles, and the processes contributing to the state of stress and rates of strain in plate interior regions. The principal findings of the research to date are described. For individual titles, see N88-12206 through N88-12208.

N88-12206*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
EARTHQUAKE SOURCE MECHANISMS AND TRANSFORM FAULT TECTONICS IN THE GULF OF CALIFORNIA Abstract Only
John A. Goff, Eric A. Bergman, and Sean C. Solomon *In its* The Interpretation of Crustal Dynamics Data in Terms of Plate Motions and Regional Deformation Near Plate Boundaries 20 Nov. 1987 p 4-5 Presented at the IUGG General Assembly, Vancouver, British Columbia, 9-22 Aug. 1987 (For primary document see N88-12205 03-46)
Avail: NTIS HC A07/MF A01 CSCL 08G

The source parameters of 19 large earthquakes in the Gulf of California were determined from inversions of long-period P and SH waveforms. The goal was to understand the recent slip history of this dominantly transform boundary between the Pacific and North American plates as well as the effect on earthquake characteristics of the transition from young oceanic to continental lithosphere. For the better recorded transform events, the fault strike is resolved to + or - 4 deg at 90 percent confidence. The slip vectors thus provide important constraints on the direction of relative plate motion. Most centroid depths are poorly resolved because of tradeoffs between depth and source time function. On the basis of waveform modeling, historical seismicity, and other factors, it is appropriate to divide the Gulf into three distinct zones. The difference in seismic character among the three zones is likely the result of differing levels of maturity of the processes of rifting, generation of oceanic crust, and formation of stable oceanic transform faults. The mechanism of an earthquake on the Tres Marias Escarpment is characterized by thrust faulting and likely indicates the direction of relative motion between the Rivera and North American plates. This mechanism requires revision in plate velocity models which predict strike slip motion at this location. Author

N88-12207*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
INTERSEISMIC DEFORMATION FOR NORMAL FAULT EARTHQUAKES Abstract Only
Robert Reilinger *In its* The Interpretation of Crustal Dynamics Data in Terms of Plate Motions and Regional Deformation Near Plate Boundaries 20 Nov. 1987 p 6-7 Presented at the Fall AGU Meeting, San Francisco, Calif., 7-11 Dec. 1987 (For primary document see N88-12205 03-46)
Avail: NTIS HC A07/MF A01 CSCL 08G

Comparison between the coseismic vertical deformation associated with normal fault earthquakes and permanent deformation indicated by geologic structure indicates that large deformation must occur during the period between earthquakes. When sufficient geodetic and geologic information is available it is possible to estimate the spatial character of this interseismic

deformation. A case in point is the 1983 Borah Peak, Idaho earthquake. This normal fault earthquake produced roughly 5 times as much basin subsidence as it did uplift of the adjacent mountain ranges. In contrast, geophysical and geological observations show that the basin is roughly as deep as the bounding range is high. A similar normal fault event in the Basin and Range, the 1959 Hebgen Lake earthquake, was also accompanied by substantially larger subsidence than uplift. In this case, postseismic geodetic measurements show broad regional uplift with a spatial pattern which is roughly consistent with that proposed for the Borah Peak event. Modeling suggests that postseismic viscoelastic relaxation and strain accumulation in an elastic lithosphere overlying a viscoelastic asthenosphere are possible physical mechanisms to generate interseismic uplift. These mechanisms may be the contemporary expression of those processes responsible for the high elevation of the Basin and Range Province. Author

N88-12208*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
TRANSFORM FAULT EARTHQUAKES IN THE NORTH ATLANTIC: SOURCE MECHANISMS AND DEPTH OF FAULTING
Eric A. Bergman and Sean C. Solomon *In its* The Interpretation of Crustal Dynamics Data in Terms of Plate Motions and Regional Deformation Near Plate Boundaries 20 Nov. 1987 119 p
(For primary document see N88-12205 03-46)
Avail: NTIS HC A07/MF A01 CSCL 08G

The centroid depths and source mechanisms of 12 large earthquakes on transform faults of the northern Mid-Atlantic Ridge were determined from an inversion of long-period body waveforms. The earthquakes occurred on the Gibbs, Oceanographer, Hayes, Kane, 15 deg 20 min, and Verna transforms. The depth extent of faulting during each earthquake was estimated from the centroid depth and the fault width. The source mechanisms for all events in this study display the strike slip motion expected for transform fault earthquakes; slip vector azimuths agree to 2 to 3 deg of the local strike of the zone of active faulting. The only anomalies in mechanism were for two earthquakes near the western end of the Verna transform which occurred on significantly nonvertical fault planes. Secondary faulting, occurring either precursory to or near the end of the main episode of strike-slip rupture, was observed for 5 of the 12 earthquakes. For three events the secondary faulting was characterized by reverse motion on fault planes striking oblique to the trend of the transform. In all three cases, the site of secondary reverse faulting is near a compression jog in the current trace of the active transform fault zone. No evidence was found to support the conclusions of Engeln, Wiens, and Stein that oceanic transform faults in general are either hotter than expected from current thermal models or weaker than normal oceanic lithosphere. Author

N88-12209# Danish Meteorological Inst., Copenhagen. Div. of Geophysics.
NARSSARSSUAQ GEOPHYSICAL OBSERVATORY: MAGNETIC RESULTS, 1980-83. INSTRUMENTATION AND FORMULAS Progress Report
1986 39 p
(ISBN-87-7478-280-0; ETN-87-90757) Avail: NTIS HC A03/MF A01

The results of the standard observations carried out at the Narssarssuaq magnetic laboratory during 1980-82 are presented. The measurements show hourly means and ranges. Annual mean values for 1983 are given. ESA

N88-12210# Danish Meteorological Inst., Copenhagen. Div. of Geophysics.
CONFIGURATIONS OF THE QUIET POLAR CAP AND ITS RESPONSE TO A SUDDEN INCREASE OF THE ENERGY INPUT RATE EPSILON
K. Lassen, C. Danielsen, T. S. Joergensen, and C.-I. Meng 1986 35 p Presented at the International Symposium on Polar Geomagnetic Phenomena, Suzdal, USSR, May 1986
(DMI-Geophys-Papers-R-74; ISBN-87-7478-273-8; ETN-87-90758)
Avail: NTIS HC A03/MF A01

Following a geomagnetically quiet period of 17 hr duration a sudden increase of the solar wind-magnetosphere energy coupling function epsilon to greater than 100 billion W occurred at 0510 UT on Nov. 29, 1984, and a moderate substorm onset was observed in the midnight sector of the auroral oval at 0612 UT. The shape and position of the boundary of the polar cap during quiet conditions, and the influence of the sudden disturbance on the boundary position were studied. It is concluded that an equatorward shift of the polar cap boundary caused by an increase in epsilon may be observed at part of the boundary earlier than the corresponding shift of the auroral oval. The shift may take place at different hours in different sectors of the polar cap with time differences of at least 20 min between dawn and dusk. ESA

N88-12211# Danish Meteorological Inst., Copenhagen. Div. of Geophysics.
HIGH LATITUDE PROBLEMS TO BE STUDIED BY INCOHERENT SCATTER RADARS
T. S. Joergensen 1987 37 p Paper presented at Incoherent Scatter Technique Summer School, Tromsoe, Norway, 4-16 Aug. 1986
(DMI-Geophys-Papers-R-77; ISBN-87-7478-283-5; ETN-87-90759)
Avail: NTIS HC A03/MF A01

The use of incoherent scatter radar to study ionospheric and magnetospheric phenomena is discussed. Electric fields; field aligned electric currents; auroras; substorms; and solar wind-magnetosphere interactions are considered. ESA

N88-12212# SRI International Corp., Menlo Park, Calif.
A COMPARATIVE ANALYSIS OF EQUATORIAL AND AURORAL-ZONE PHASE SCINTILLATION DATA Technical Report, 13 Mar. 1985 - 30 Sep. 1986
Charles L. Rino and Teri M. Dabbs 1 Oct. 1986 74 p
(Contract DNA001-86-C-0002)
(AD-A184509; DNA-TR-86-403) Avail: NTIS HC A04/MF A01 CSCL 20N

A comparison is made between equatorial and auroral-zone phase scintillation. The spectral characteristics of weak-scatter phase scintillation data collected at two equatorial ground stations are contrasted with similar data collected at two auroral-zone ground stations. An automated, multisegmented fitting procedure was used to determine these characteristics. Three types of spectra were found. Despite temporal and spatial differences, the two equatorial data sets have similar spectral characteristics. The auroral-zone sets are also similar. In contrast, the spectral characteristics of the two latitude regions are quite different from each other. GRA

N88-12213# Bedford Research Associates, Mass.
BALLOON TRACK DATA ANALYSIS Final Report, 3 Jul. 1985 - 31 Mar. 1987
P. Burkhardt, R. Fowler, and M. Moses 31 Mar. 1987 39 p
(Contract F19628-85-C-0099)
(AD-A184750; AFGL-TR-87-0112) Avail: NTIS HC A03/MF A01 CSCL 08D

The primary goal of this program was to design a post-flight data processing system to measure gravity to 1 mgal accuracy. The purpose was to analyze data from balloons flights and to assess the feasibility of measuring gravity to this accuracy. Emphasis during the effort would be on determining the relative contribution of the various error sources to the overall error budget. Primary emphasis was on assessing the performance of GPS as the main tracking system. To facilitate this assessment, a direct comparison of the accuracies in determining gondola position, velocity, and acceleration will be made between GPS tracking, radar tracking, and tracking performance. It is anticipated that using a differential-GPS approach would yield position, velocity, and acceleration accuracies which are significantly better than ground-based radar. The proposed method of estimating gravity based on gravimeter, gondola package tracking data, and inertial

motion sensing package data involves an integrated high-order Kalman filter approach. GRA

N88-12214# Earth Technology Corp., Long Beach, Calif.
HYPOCENTERS (1977-1984) AROUND THE RICHTON DOME AND THE MELVIN, ALABAMA, 1978 EARTHQUAKE
Aug. 1987 43 p Prepared in cooperation with Battelle Memorial Inst., Columbus, Ohio
(Contract DE-AC02-83CH-10140)
(DE87-014336; BMI/ONWI-659) Avail: NTIS HC A03/MF A01

Seventeen detected earthquakes (1977 to 1984) in the eastern Mississippi and Alabama region are relocated to determine location accuracy and what depth constraints are available. Arrival time data from the Southeastrn US Seismic Network (SEUSSN) bulletins and five different velocity models are used to recalculate the hypocenter locations. Differences in locations depending on the velocity model used are small both inside the seismograph network in Alabama and at the edge of the network in eastern Mississippi. The calculated standard horizontal location errors range from 1 to 19 km, although most of the locations have errors from 2 to 10 km. In most cases, the depth is unconstrained. Since only 17 earthquakes occurred during a 7-year period in a large geographical area, no simple conclusions can be drawn about the rate of seismic activity or correspondence between earthquakes and geologic structures. The December 11, 1978, Melvin, Alabama, earthquake (m(sub bLg) = 3.5) is relocated and its possible mechanism is discussed because of its proximity to the Richton Dome. The epicenter is located near the Pickins-Gilbertown fault zone and near the Mississippi-Alabama state line. The mechanism of the Melvin earthquake cannot be determined, but the event is interpreted to be a natural tectonic event rather than an artificially induced event. DOE

N88-12215# Naval Postgraduate School, Monterey, Calif.
PROPERTIES OF THE ATMOSPHERIC BOUNDARY LAYER ABOVE A SUBTROPICAL OCEANIC FRONT M.S. Thesis
John P. Higgins Jun. 1987 99 p
(AD-A184006) Avail: NTIS HC A05/MF A01 CSCL 04B

The marine atmospheric boundary layer (MABL) and synoptic-scale situation is described using rawinsonde and sea-surface temperature (SST) data collected during the 1986 Frontal Air-Sea Interaction Experiment (FASINEX). The data obtained from 14 February to 09 March 1986 are divided into eight consecutive three-day periods and analyzed. Significant changes in synoptic-scale features and flow patterns occurred during each three-day period due to movement of low pressure systems. MABL changes noted were due primarily to large scale convergence. Thirteen pairs of rawinsonde launches, seven from opposite sides of an oceanic front and six from the same side (five warm, one cold) are compared. The time difference between soundings in each pair did not exceed sixty minutes. Boundary layer height, mixed layer potential temperature and specific humidity differences between paired rawinsonde launches were larger when launches were from opposite sides of the oceanic front. A combination of both shipboard and aircraft data will be necessary to further describe the conditions of the MABL and synoptic-scale situation. GRA

N88-12216# Atmospheric and Environmental Research, Inc., Cambridge, Mass.
SPECTROSCOPIC AND RETRIEVAL STUDIES IN SUPPORT OF SCRIBE (STRATOSPHERIC CRYOGENIC INTERFEROMETER BALLOON EXPERIMENT) Final Report, 8 Aug. 1986 - 8 Feb. 1987
L. D. Kaplan, R. G. Isaacs, and R. D. Worsham 8 Mar. 1987 52 p
(Contract F19628-86-C-0172)
(AD-A184037; P173F; AFGL-TR-87-0084) Avail: NTIS HC A04/MF A01 CSCL 04A

A FASCODE based physical retrieval algorithm for atmospheric temperature sounding is developed in support of data analysis for the SCRIBE high resolution interferometer using a modified version of FASCODE capable of treating highly opaque regions such as the CO2 Q branch at 667/cm, radiances are simulated for comparison to SCRIBE data and the effects of line mixing are evaluated. GRA

N88-12217# Naval Research Lab., Washington, D.C.
EAST COAST GRAVITY VALIDATION STUDY Final Report, 1 Mar. 1986 - 31 Oct. 1987
John M. Brozena and Mary F. Peters 21 Aug. 1987 17 p
(AD-A184292; NRL-MR-5972) Avail: NTIS HC A02/MF A01 CSCL 08E

NRL has recently completed an experiment in airborne gravimetry off the Southeast coast of the United States. This report describes the techniques of airborne gravimetry employed and the methods used to process and analyze the collected data. Results from the analysis of the study are presented. GRA

N88-11706 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
MORPHOLOGY OF THE EARTH'S ENVIRONMENT [MORPHOLOGIE DE L'ENVIRONNEMENT TERRESTRE]
H. Reme *In* CNES, Space Environment Technology Apr. 1987 p 73-100 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11707 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
RADIATION BELTS
R. Gendrin *In* CNES, Space Environment Technology Apr. 1987 p 101-124 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11709 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
IONOSPHERE AND PLASMASPHERE [IONOSPHERE ET PLASMASPHERE]
J. C. Cerisier *In* CNES, Space Environment Technology Apr. 1987 p 195-208 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11711 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
MAGNETOSPHERIC STORMS [LES ORAGES MAGNETOSPHERIQUES]
Jean-Andre Sauvaud *In* CNES, Space Environment Technology Apr. 1987 p 249-260 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11718 Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
A SIMPLIFIED APPROACH TO THE DYNAMICS OF CHARGED PARTICLES IN THE MAGNETOSPHERE
Michel Blanc *In* CNES, Space Environment Technology Apr. 1987 p 429-439 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11885# Joint Publications Research Service, Arlington, Va.
METHOD ESTIMATING INTEGRAL MEAN VALUE OF ENHANCEMENT FACTOR AND PATH LATITUDE FOR WHISTLERS BELOW MAGNETIC LATITUDE 10 DEG Abstract Only
Youshan Wang *In its* JPRS report: Science and Technology: China 14 Jul. 1987 p 21 Transl. into ENGLISH from Kongjian Kexue Xuebao (Beijing, Peoples Repubic of China), v. 7, no. 2, Apr. 1987 p 146-153 (For primary document see N88-11880 03-31)
Avail: NTIS HC A07/MF A01

N88-12161# International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
SPOT FOR EARTHQUAKE HAZARD ZONING IN SOUTHERN ITALY, A PROVISIONAL REPORT
H. Th. Verstappen and R. J. Elsinga *In* CNES, SPOT 1: First In-Flight Results 1987 p 151-156 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12163# Nevada Univ., Reno. Mackay School of Mines.
APPLICATION OF SPOT-1 DATA TO MINERAL EXPLORATION IN NEVADA
James V. Taranik and Marcus X. Borengasser *In* CNES, SPOT 1: First In-Flight Results 1987 p 167-172 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12164# Paris VI Univ. (France).
GEOLOGICAL INTERPRETATION OF A SPOT IMAGE OVER KENYA: THE GREGORY RIFT NETWORK OF FAULTS
J. Chorowicz, G. Vidal, and J. P. Rudant *In* CNES, SPOT-1: First In-Flight Results 1987 p 173-179 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12165# Bureau de Recherches Geologiques et Minieres, Minieres, Paris (France).
EVOLUTION OF REMOTE SENSING UTILIZATION IN GEOLOGICAL MAPPING AND ORE EXPLORATION: EXAMPLE IN ZIMBABWE
J. Y. Scanvic *In* CNES, SPOT 1: First In-Flight Results 1987 p 181-185 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-12218# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data and Information Service.
PUBLICATIONS AND FINAL REPORTS ON CONTRACTS AND GRANTS, 1986 (NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE)
N. A. Everson Apr. 1987 25 p
(PB87-220810; NOAA-TM-NESDIS-17) Avail: NTIS HC A03/MF A01 CSCL 04B

Contents include: publications by National Environmental Satellite Data and Information Service (NESDIS) staff members in 1986, and final reports on contracts and grants sponsored by NESDIS. GRA

N88-12219# Texas Univ., Austin. Center for Energy Studies.
CALENDAR YEAR 1985 SOLAR AND WEATHER DATA FOR AUSTIN, TEXAS
C. M. Sloan, G. C. Vliet, and B. D. Hunn Mar. 1987 245 p
(PB87-220174; CONSERVATION AND SOLAR-RR-3) Avail: NTIS HC A11/MF A01 CSCL 04B

The Department of Mechanical Engineering and the Center for Energy Studies at the University of Texas at Austin maintain a monitoring station on the roof of the Engineering Teaching Center that provides measured solar and weather data for Austin, Texas. The station has been operational since July 1, 1984, and provides hourly data for the following: (1) global horizontal solar radiation; (2) direct beam solar radiation; (3) calculated diffuse horizontal solar radiation; (4) measured diffuse horizontal solar radiation; (5) clearness index; (6) wind speed; (7) wind direction; (8) dry-bulb temperature; and (9) relative humidity. The report describes the solar/weather station and the calibration of its instruments, and details the methodology developed for quality control and editing of the measured data. GRA

N88-12220# National Center for Atmospheric Research, Boulder, Colo.
DOCUMENTATION OF NCAR (NATIONAL CENTER FOR ATMOSPHERIC RESEARCH) CCM1 PROGRAM MODULES
L. M. Bath, M. A. Dias, D. L. Williamson, G. S. Williamson, and R. J. Wolski Jul. 1987 330 p
(Grant NSF ATM-82-17015)
(PB87-213567; NCAR/TN-287/1A) Avail: NTIS HC A15/MF A01 CSCL 04B

Described in detail are the program modules and FORTRAN Common storage blocks which comprise the NCAR (National Center for Atmospheric Research) Community Climate Model Version CCM1. Each program module, i.e., main program, subroutine or function, is described separately, the description including the calling sequence, purpose, description of dummy arguments, if any, and the algorithm used by the module. Common storage blocks are described variable by variable, with value, variable type and indication of which program module defines the variable where appropriate. Included are descriptions of the FORTRAN PARAMETER statements in the Model. The document is intended for use as a companion to the Model source code in understanding and modifying the Model. GRA

N88-12221# Commission of the European Communities (Luxembourg).
SHORT REFERENCE YEAR Final Report
L. Hallgreen 1985 81 p
(PB87-107470; EUR-10202-EN) Avail: NTIS HC E04/MF E04; customers in the European Community countries should apply to the Office for Official Publications of the European Communities, B.P. 2985, Luxembourg CSCL 04B

In the final report a mathematical method to generate the short reference year (SRY), in which the number of hourly weather data is reduced to 25 percent of a full year, is described. Furthermore, the test results of computer simulations are shown and compared with tests results from other short reference years. The project has participated in the EEC research program sector F Solar Radiation Data under section 2 Reference Year. The aim of this action with regard to SRY is to develop four operational methods for generating SRY from existing basic ideas. These methods will be evaluated, and the best will be used for generation of SRY's for a number of locations within EEC. GRA

N88-12222# European Space Agency, Paris (France).
DEFINITION AND USE OF SENSORS FOR MEASURING ELECTRICAL CONDUCTIVITY IN THUNDERCLOUDS
P. Gondot Jul. 1987 142 p Transl. into ENGLISH of Definition et Exploitation de Capteurs Adaptes a la Mesure de la Conductivite Electrique dans les Nuages dOrages (Chatillon, France) Original language document was previously announced as N87-20705
(ESA-TT-1047; ONERA-NT-1986-4; ETN-87-91119) Avail: NTIS HC A07/MF A01

The electrical behavior of a convective cloud is related to global parameters like the atmospheric electric field and to local phenomena like the electric charge of hydrometeors and the electric ionic conductivity of the medium. Different sensors were designed and installed on an aircraft. The experimental devices are described and results of the airborne experiments are presented. A positive monopole zone of ionic density was detected in clear sky at the edge of convective clouds, at 6000 m altitude. ESA

N88-12223# European Space Agency, Paris (France).
RADAR MEASUREMENT METHODS FOR THE OBSERVATION OF CONVECTIVE CLOUDS, AND COMPARISON OF MEASUREMENTS AND NUMERICAL SIMULATION
Herbert Schuster Jun. 1987 44 p Transl. into ENGLISH of Radarmessmethoden fuer die Beobachtung Konvektiver Wolken und Vergleich von Messung und Numerischer Simulation (Oberpfaffenhofen, Federal Republic of Germany) Original language document was previously announced as N87-26477
(ESA-TT-1049; DFVLR-FB-86-42; ETN-87-91120) Avail: NTIS

HC A03/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 16

Radar measurement methods for the investigation of radar reflectivity precipitation rate, and liquid water content in isolated, convective clouds are described. The computer controlled radar system allows the representation of the parameters in the form of three-dimensional, time dependent variables. The limiting conditions during the observation of objects which vary in time and space are discussed. Measurement accuracy is estimated. Results of case studies, especially the comparison of radar data with results of one-dimensional convective cloud simulation, are demonstrated. ESA

N88-12224# European Space Agency, Paris (France).
STUDY OF ISOLATED CONVECTIVE CLOUDS IN THE LOWER ALPS IN SUMMER 1984, USING RADAR AND A SIMPLE WEINSTEIN NUMERICAL MODEL
Heinrich Salbreiter Sep. 1987 79 p Transl. into ENGLISH of Untersuchung Isolierter Konvektiver Wolken em Sommer 1984 im Voralpengebeit Mittels Radar und Einfachen Rechenmodells Nach Weinstein (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Se. 1986 Original language document was announced as N87-26479
(ESA-TT-1061; DFVLR-FB-86-52; ETN-87-91126) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM26.50

Isolated, single-cell convective clouds in the lower Alps were studied by radar. The cloud parameters maximum radar reflectivity, maximum cell-echo height, maximum precipitation area, and maximum cloud base radius were measured, related to each other, and corresponding correlation coefficients were computed by regression analysis. The dependence of these parameter correlations on the actual weather situation, the degree of lability, and the geographic location, was determined. The population was divided into high-reaching cumulus congestus clouds, and medium attitude cumulonimbus. Different parameter relationships for these two cumulus types are found. Comparison between experimental results and computations with a one-dimensional numerical model for isolated single-cell cumulus clouds shows that the Weinstein model is suited for estimates of the convectivity. ESA

N88-12225# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Transportfysica.
A MODEL FOR THE CONVECTIVE ATMOSPHERIC BOUNDARY LAYER DURING THE WINTER IN THE KHARTOUM REGION (SUDAN)
M. Rutten Dec. 1986 82 p
(R-822-A; ETN-87-91314) Avail: NTIS HC A05/MF A01

In order to evaluate a methodology to estimate the wind potential in tropical regions, the boundary layer at Khartoum is analyzed. Upper-air data show that the boundary layer is convective. Pressure and temperature charts show that the horizontal temperature gradient is the driving force of the wind. A model for the convective boundary layer starting from the general equations for the atmosphere was constructed. It is a modified Ekman layer, in which the wind speed is corrected for the existance of thermals. The model was tested for winter data of Khartoum and for data of the Wangara (Australia) experiment. The deviation between the calculated and measured wind speed is within 10% for a stationary atmosphere. ESA

N88-12226# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Analysis and Prediction Div.
OCEAN MODEL PROCESSOR FOR CLIMATE STUDIES
T. W. Bettge Apr. 1987 39 p
(Grant NSF ATM-82-17015)
(PB87-224713; NCAR/TN-279/1A) Avail: NTIS HC A03/MF A01 CSCL 04B

The purpose of the technical note is to describe and demonstrate the capabilities of an ocean model processor for climate studies. The processor is a tool for the analysis of history data from a particular family of oceanic general circulation models, and can be used for a wide class of ocean investigations ranging from eddy-resolving modeling studies to global climate simulations. It is designed to execute within the National Center for Atmospheric Research (NCAR) Scientific Computing Division environment on the CRAY supercomputers using datasets which reside on the mass storage system. The primary product from the processor is a two-dimensional contour analysis of data which was represented originally in the four dimensions of space and time. Data can be averaged over any dimension and plotted within any two-dimensional cross-section subset. Several examples are given in order to illustrate the capabilities of the processor. GRA

N88-12227# Princeton Univ., N. J. Dept. of Statistics.
KINDS OF BOOTSTRAPS AND KINDS OF JACKKNIVES, DISCUSSED IN TERMS OF A YEAR OF WEATHER-RELATED DATA
John W. Tukey Apr. 1987 60 p
(Contract DAAL03-86-K-0073)
(AD-A184495; ARO-23360.6-MA) Avail: NTIS HC A04/MF A01 CSCL 04B

Resampling methods are becoming popular ways of assessing the standard error appropriate to some number chosen to distill, perhaps in a rather complex way, from data. An ever-present danger is that resampling will come to be thought of as a cure-all. The most that can reasonably be hoped for is that questions that do not arise in connection with the simplest distillates (arithmetic means of samples) need not be considered in connection with resampling applied to the results of more commplicated calculations. This means that, in particular, (1) needs for the use of robust/resistant techniques in the distillation process, and (2) needs to consider the question of the proper error term are in no way automatically addressed by the use of jackknife or bootstrap. Robust/resistant techniques, if required, must be built into calculation of the final distillate from the observations, before that distillate is jackknifed or bootstrapped. A year of weather-related data offers a good platform for careful discussion. GRA

N88-12228# Coastal Engineering Research Center, Vicksburg, Miss.
HURRICANE ELENA STORM SURGE DATA Technical Report, 1985 - 1986
Andrew C. Garcia and William S. Hegge Jul. 1987 81 p
(AD-A184573; CERC-TR-87-10-3; Rept-3) Avail: NTIS HC A05/MF A01 CSCL 08C

A summary of storm surge high-water mark, hydrograph, and wave data acquired during and subsequent to Hurricane Elena is presented. The data were obtained and assembled as part of a long-term research effort by the US Army Corps of Engineers to establish a quantitative data set with the objective of providing in a series of documents the data necessary for simulation and verification of numerical surge models. The data contained herein were obtained primarily by the US Army Engineer Waterways Experiment Station and the US Army Engineer District, Mobile, of the US Army Corps of Engineers with supplemental data from contributing agencies and institutions. Additional information is included in the form of photographs and descriptive narrative to aid investigators in assessing the degree of importance of an individual measurement for the purpose of model verification. Author (GRA)

N88-12229# Naval Postgraduate School, Monterey, Calif.
TROPICAL CYCLONE INTENSITY PREDICTION BASED ON EMPIRICAL ORTHOGONAL FUNCTION REPRESENTATION OF WIND AND SHEAR FIELDS M.S. Thesis
Edward L. Weniger Jun. 1987 56 p
(AD-A184699) Avail: NTIS HC A04/MF A01 CSCL 04B

An objective techniques for predicting 24, 48 and 72 h tropical cyclone intensity is investigated using 1216 cases in the western North Pacific from 1979 to 1983. Potential predictors include conventional storm-related parameters, such as date, intensity, motion and position. Additional potential predictors include empirical orthogonal function (EOF) coefficients of the zonal and meridonal components of the environmental wind (250, 400 and 700 mb) and vertical wind-shear (250-400, 400-700, and 250-700 mb) fields.

These coefficients represent the synoptic forcing in the vicinity of the storm. The intensity change information is filtered to eliminate data for storms affected by landfall from the sample. The regression equations are verified against a homogeneous sample of Joint Typhoon Warning Center (JTWC) official forecasts, which are also demonstrated to be significantly better (95% confidence) than persistence at all forecast intervals. Regression equations developed using EOF coefficient predictors along with conventional predictors are comparable to the JTWC official forecast, even at 48 and 72 h. The regression equations based on the complete set of predictors have slightly more skill than those based only on conventional predictors. If the regression equations are derived from a smaller sample to allow for an independent test, the results appear to be better in the dependent set, but are degraded in the independent sample. Author (GRA)

N88-12230# Lawrence Livermore National Lab., Calif.
THE DEVELOPMENT OF LOW LEVEL COASTAL FLOW FIELDS WHEN SOLAR RADIATION IS BLOCKED BY SMOKE
C. R. Molenkamp Aug. 1987 14 p Presented at the 19th General Assembly International Union of Geodesy and Geophysics, Vancouver, British Columbia, 9 Aug. 1987
(Contract W-7405-eng-48)
(DE87-014348; UCRL-96144; CONF-8708132-1) Avail: NTIS HC A02/MF A01

Thick layers of smoke, injected into the atmosphere by fires ignited by a nuclear exchange, would block the incident solar radiation and allow continental regions to cool while oceanic areas remain at constant temperature. It has been suggested that the resultant horizontal temperature gradient could initiate precipitation along the coastline that would rapidly scavenge the smoke. This hypothesis is investigated using an enhanced version of the Colorado State University mesoscale model to simulate the flow field in the vicinity of continental coastlines. The model is modified to include cloud formation and the effects of these clouds on the transfer of infrared radiation as well as improving the basic long wave radiation parameterization. For moderate westerly winds over the east coast (offshore flow), a layer of fog forms just above the ground that, after about 2 days, evolves into a stratus cloud. Over the ocean a similar stratus cloud forms because of upward mixing of water vapor and radiative cooling. Once these similar cloud layers form, the cooling rates over land and sea become nearly the same eliminating the proposed mechanism for development of convective precipitation and scavenging of mid- or high-level smoke. For the same westerly winds on the west coast (onshore flow), the sequence is similar but evolves more quickly because more moisture is present in the upwind maritime air. In both cases, the formation of ground fog prevents the air temperature in the surface layer from falling below the temperature at which saturation occurs. Before the temperature decreases further, moisture must be removed from the layer. DOE

N88-12231# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
STUDY OF MICROBURST DETECTION PERFORMANCE DURING 1985 IN MEMPHIS, TENNESSEE
John T. DiStefano 5 Aug. 1987 34 p
(Contract F19628-85-C-0002)
(AD-A184013; ATC-142; DOT/FAA/PM-87/18) Avail: NTIS HC A03/MF A01 CSCL 04B

This report focuses on the detectability of microbursts using pulse Doppler weather radars and surface anemometers. The data used for this study were collected in the Memphis, TN area during the FLOWS (FAA/Lincoln Laboratory Observational Weather Studies) project of 1985. The methods used for declaring a microburst from both Doppler radar and surface anemometer data are described. The main objective of this report was to identify the results that were generated by comparing the 1985 radar detected microbursts (which impacted the surface anemometer system) with the surface mesonet detected microbursts. In so doing, the issue of missed microburst detections, for which there occurred two (both by the radar), is identified. Possible reasons as to why these two microbursts were not detected are discussed in detail. GRA

N88-12232# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
A METHOD FOR REMOTE SENSING OF PRECIPITABLE WATER VAPOR AND LIQUID IN THE ATMOSPHERE USING A 22-GHZ RADIOMETER Final Report
Fred I. Shimabukuro 3 Aug. 1987 18 p
(Contract F04701-85-C-0086)
(AD-A184204; TR-0086(6925-06)-3; SD-TR-87-38) Avail: NTIS HC A03/MF A01 CSCL 04B

A well known method for retrieving the precipitable water vapor (V) and liquid (L) in a nonprecipitating atmosphere utilizes a dual channel radiometer operating at 20.6 and 31.6 GHz. Statistical retrieval algorithms are used for the determination of V and L. In this study a somewhat different method for retrieval of the quantities V and L, using a radiometer, is described. The atmospheric opacities are determined at three frequencies, (nu1, nu2, nu3) near the water vapor line, from emission measurements. The frequency nu2 is the line center, and the frequencies, nu1 and nu3, are chosen such that (nu2)sq. = (nu1)sq + (nu3)sq. From these three measurements, a differential opacity which is dependent only on the resonant part of the water vapor absorption is derived. From this quantity, estimates of V and the clear atmosphere attenuation are obtained. The cloud opacity is obtained by subtracting the clear atmosphere attenuation from the total attenuation. In light rain the quantity V can be retrieved using this technique. GRA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-12233# Integrated Systems Analysts, Inc., Chula Vista, Calif.
POROSITY INFLUENCE ON THE STRENGTH AND ELASTICITY OF FIRST-YEAR SEA ICE Final Report, Jun. - Sep. 1986
J. H. Brown Jul. 1987 18 p
(Contract N66001-86-M-B416; S17-39)
(AD-A184493; NOSC-TD-1109) Avail: NTIS HC A03/MF A01 CSCL 08L

This review of theoretical models of elasticity and flexural strength of sea ice is to establish a baseline for future efforts in experimental and theoretical work in these areas. For example, brine content is not the total porosity of sea ice. Total porosity of sea ice is brine plus gas content. Other factors whichmight influence the models and should be considered in any theoreticaal models for sea ice strengths and elasticity are: Visco-elastic and plastic effects along the failure plane as well as slippage. The distribution and geometry of the pores. Gas porosity must be taken into consideration. Consider other configurations for theoretical models. Surface tension effects on the cohesion of the ice platelets. Effects of solid salts on cold ice. GRA

N88-12234# Naval Postgraduate School, Monterey, Calif.
UNDERWATER ACOUSTIC BACKSCATTER FROM A MODEL OF ARCTIC ICE OPEN LEADS AND PRESSURE RIDGES M.S. Thesis
Michael J. Browne Jun. 1987 161 p
(AD-A184693) Avail: NTIS HC A08/MF A01 CSCL 20A

Behavior of monostatic backscatter from Arctic open leads and pressure ridges was studied using scale models in the laboratory under controlled conditions. Experiments were performed in an anechoic tank using pulsed transmissions from underwater point sources to measure the backscatter from several different floating acrylic plates by the selection of the acrylic material, and the geometrical properties of the ice in features were accurately scaled by maintaining the appropriate dimension-to-wavelength ratios. The

characteristic behavior of the backscatter was explained using both diffraction theory and mode-conversion concepts. It was generally observed that a significant amount of the incident acoustic energy resulted in solidborne vibrations and propagating waves within the floating plate. The ability of those vibrations to reradiate energy into the water resulted in greater backscatter than predicted from the trailing edge of an open lead and piston-like radiation from pressure rigid models. GRA

N88-12235# Naval Polar Oceanography Center, Washington, D.C.
EASTERN - WESTERN ARCTIC SEA ICE ANALYSIS 1986 Annual Reference Report No. 13, period ending 1986
Aug. 1987 107 p
(AD-A184016) Avail: NTIS HC A06/MF A01 CSCL 08L

Approximately 7-days' analysis of sea ice data, prepared by the Naval Polar Oceanography Center, Suitland, MD is presented. Included are ice concentrations and ice thickness (age). GRA

N88-12236# California Univ., Santa Cruz.
THE EFFECT OF OCEAN FLUCTUATIONS ON SOUND TRANSMISSION IN THE OCEAN Final Technical Report, 1 Oct. 1977 - 30 Sep. 1987
Stanley M. Flatte 30 Sep. 1987 7 p
(Contract N00014-77-C-0475)
(AD-A184382) Avail: NTIS HC A02/MF A01 CSCL 20A

The objective is to develop a general theoretical framework for calculating fluctuations of signals on waves propagated through random media (WPRM) and to apply this framework to sound through the ocean. Comparison with real data is an important aspect of the effort. We have made quantitative and reliable our ability to calculate the effects of internal waves on oceanic sound transmission, over a wide range of parameters. Ranges may vary from a few hundred meters to thousands of kilometers, while frequencies from 50 Hertz to 100 kHz can be treated. GRA

N88-12237# California Univ., Santa Cruz. Dept. of Physics.
AFAR (AZORES FIXED ACOUSTIC RANGE) MEASUREMENTS OF INTENSITY AND INTENSITY MOMENTS
Stanley M. Flatte, Stephen A. Reynolds, Roger Dashen, Barry Buehler, and Pat Maciejewski Sep. 1986 30 p Sponsored by Naval Underwater Systems Center, New London, Conn.
(AD-A184431) Avail: NTIS HC A03/MF A01 CSCL 20A

In an acoustic-oceanographic experiment (AFAR) performed near the Azores in 1975, frequencies from 400 to 4670 Hz were transmitted over a 35-km wholly refracted patch. In addition, a separate data set was gathered over a 3-km path in 1973. Measurements of the intensity coherence function of time and frequency, intensity moments, and the probability distribution of intensity are presented and compared with predictions of fluctuations due to internal waves. GRA

N88-12175# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
USE OF SPOT IMAGES FOR COASTAL DEVELOPMENT AND INVENTORY OF AQUACULTURAL SITES IN NEW CALEDONIA (ALIAS PROJECT). FIRST RESULTS [UTILISATION DES IMAGES SPOT POUR L'AMENAGEMENT LITTORAL ET L'INVENTAIRE DES SITES AQUACOLES EN NOUVELLE CALEDONIE (PROJECT ALIAS). RESULTATS PRELIMINAIRES]
L. Loubersac, A. Grotte, and M. Viollier *In* CNES, SPOT 1: First In-Flight Results 1987 p 267-273 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12176# Societe Europeenne de Propulsion, Puteaux (France). Image Processing Div.
CONTRIBUTION OF SPOT DATA TO THE PHYSIOGRAPHIC STUDY OF COASTAL ENVIRONMENT: LA POINTE D'ARCAY AND L'ANSE DE L'AIGUILLON (FRANCE)
Philippe Rebillard and Fernand Verger (Centre National de la Recherche Scientifique, Paris, France) *In* CNES, SPOT 1: First In-Flight Results 1987 p 275-280 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12177# Dakar Univ. (Senegal). Inst. Fondamental d'Afrique Noire.
COASTAL DYNAMICS OF THE MOUTH OF THE SALOUM (SENEGAL) [LA DYNAMIQUE LITTORALE A L'EMBOUCHE DU SALOUM (SENEGAL)]
Amadou Tairou Diaw and Yves-Francois Thomas (Ecole Normale Superieure, Paris, France) *In* CNES, SPOT 1: First In-Flight Results 1987 p 281-283 In FRENCH (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France CSCL 18/64

51 LIFE SCIENCES (GENERAL)

No abstracts in this category.

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-12238# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
25 Sep. 1987 84 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-87-012) Avail: NTIS HC A05/MF A01

Topics addressed include: medicine; biochemistry; biotechnology; epidemiology; genetics; microbiology; laser materials; radiation biology; physiology; and public health. For individual titles, see N88-12239 through N88-12239.

N88-12239# Joint Publications Research Service, Arlington, Va.
EYESIGHT TRAINER FOR PILOTS
Ye. Kuznetsov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Sep. 1987 p 1-2 Transl. into ENGLISH from Izobretatel i Ratsionalizator (Moscow, USSR), no. 12, Dec. 1986 p 22 (For primary document see N88-12238 03-52)
Avail: NTIS HC A05/MF A01

It was established that a pilot has his own optimum level of brightness at which his eyesight is keenest. Any decrease or increase from the optimum level leads to a decrease in visual acuity. Varying techniques were developed, including those requiring the use of special ophthalmological instruments. One of these methods is briefly examined. B.G.

N88-12240# Ryan Research International, Chico, Calif.
HEALTH HAZARDS OF VIDEO DISPLAY TERMINALS. A COMPREHENSIVE, ANNOTATED BIBLIOGRAPHY ON A CRITICAL ISSUE OF WORKPLACE HEALTH AND SAFETY WITH SOURCES FOR OBTAINING ITEMS AND LIST OF TERMINAL SUPPLIERS
Meta Nissley, Comp. [1987] 67 p
(RSI-IAS-4; LC-87-90423; ISBN-0-942158-04-0) Avail: NTIS HC A04/MF A01

A bibliography is presented on health hazards of video display terminals. The comprehensive and annotated bibliography is about critical issues of workplace health and safety. Incresing attention is paid to the overall workplace health and comfort of the steadily growing number of video terminal users, and ergonomics is now a central theme in industrial health and safety. Arrangement of items is by title. A name index is also provided for access by author or researcher. E.R.

N88-12241# Brookhaven National Lab., Upton, N. Y.
DNA DAMAGE AND REPAIR IN HUMAN SKIN IN SITU
B. M. Sutherland, R. W. Gange (Harvard Medical School, Boston, Mass.), S. E. Freeman, and J. C. Sutherland 1987 12 p Presented at the International Conference on DNA Damage and Repair, Rome, Italy, 12 Jul. 1987 Prepared in cooperation with Harvard Medical School, Boston, MA.
(Contract DE-AC02-76CH-00016)
(DE87-014288; BNL-40073; CONF-8707103-1) Avail: NTIS HC A02

Understanding the molecular and cellular origins of sunlight-induced skin cancers in man requires knowledge of the damages inflicted on human skin during sunlight exposure, as well as the ability of cells in skin to repair or circumvent such damage. Although repair has been studied extensively in procaryotic and eucaryotic cells - including human cells in culture - there are important differences between repair by human skin cells in culture and human skin in situ: quantitative differences in rates of repair, as well as qualitative differences, including the presence or absence of repair mechanisms. Quantitation of DNA damage and repair in human skin required the development of new approaches for measuring damage at low levels in nanogram quantities of non-radioactive DNA. The method allows for analysis of multiple samples and the resulting data should be related to behavior of the DNA molecules by analytic expressions. Furthermore, it should be possible to assay a variety of lesions using the same methodology. The development of new analysis methods, new technology, and new biochemical probes for the study of dna damage and repair are described. DOE

N88-12242# Naval Submarine Medical Research Lab., Groton, Conn.
SUPEROXIDE DISMUTASE ASSAYS Interim Report
Harold W. Fisher, A. A. Messier, E. Heyder, and A. B. Callahan 16 Jun. 1987 25 p
(AD-A183972; NSMRL-M87-3) Avail: NTIS HC A03/MF A01 CSCL 06A

A number of studies support the idea that superoxide dismutase is one of the enzymes that modulates the threat of oxidative stress. This technical report presents detailed instructions for two methods presently being used at the Naval Submarine Medical Research Laboratory (NSMRL) to assay for superoxide dismutase. Both assays are of the indirect type consisting of two components: a superoxide generator and a superoxide detector. In the first method the generator produces the radical at a controlled rate, and in the absence of superoxide dismutase (SOD), the radical produced reacts with the detector. A unit of SOD then hs been defined as that amount which will reduce the rate produced by the generator to 50% of its control value. The second method, which is about 100-fold more sensitive, takes advantage of the biphasic nature of the production of the radical and its dismutation both spontaneously and by SOD. By allowing the generator to react for a specific time period before addition of the detector, a burst of reduction is obtained followed by linear rate after the detector reaches a steady state. The height of this burst in the presence and absence of SOD thereby gives a sensitive assay for which the unit (50 percent of control burst) is in the picomolar range. These assays are useful in determining SOD in a variety of tissue types such as erythrocytes obtained from Navy divers or cell culture samples that have been exposed to oxidative stress. GRA

N88-12243# Naval Submarine Medical Research Lab., Groton, Conn.
SCOTOPIC SENSITIVITY WITH 10 PERCENT OXYGEN Interim Report
S. M. Luria and Douglas R. Knight 9 Jul. 1987 17 p
(AD-A183973; NSMRL-1097) Avail: NTIS HC A03/MF A01 CSCL 06E

The night vision (scotopic) sensitivity of 6 subjects was measured while they were breathing either air (21 percent oxygen, PO2 160 torr) or 10 percent oxygen, balance nitrogen (PO2) 76 torr. Continuous monitoring showed that the mean oxygen content in the arterial blood (SaO2) dropped from 97 to 77 percent during the first seven minutes of breathing 10 percent oxygen, and there was a significant degradation of scotopic sensitivity. The reduced sensitivity was attributed solely to hypoxia with no contribution from hypocapnia. GRA

N88-12244# Washington Univ., St. Louis, Mo.
STUDIES OF THE PROCESSING OF SINGLE WORDS USING POSITRON TOMOGRAPHIC MEASURES OF CEREBRAL BLOOD FLOW CHANGE
Steven E. Petersen, Peter T. Fox, Michael I. Posner, and Marcus Raichle 1987 53 p
(Contract N00014-86-K-0289; RR0-4206)
(AD-A184058; TR-87-7-ONR) Avail: NTIS HC A04/MF A01 CSCL 05H

Language is an essential characteristic of the human species, and as such has been a focal point for study in disciplines ranging from philosophy to neurology. Cognitive and neurological investigations of language often narrow the focus of study to the processing of individual words (lexical items). Lexical processing involves a network of several levels of internal coding that can be isolated by experiment. Examples of some of these separate codes include a visual image of the form of a spoken word (visual code), pronunciation of the word (phonological code) or the association of related words (semantic codes). Studies of the time course of activation of these internal codes of words and the roles they play in performance has been a central topic in the cognitive psychology of reading and listening. Behavioral neurologists have been concerned as well with issues in lexical processing, but the focus has been in correlating the internal stages of processing with different brain regions. Recent advances in activation techniques and data analysis strategies using positron emission tomographic (PET) measurements of blood flow change have made it possible to address concerns relevant to both cognitive science and behavioral neurology. In this paper, we take advantage of these techniques to study words in normal subjects. GRA

N88-12245# Naval Postgraduate School, Monterey, Calif.
ASSESSMENT OF FATIGUE IN AVIATION CREWS M.S. Thesis
Mark L. Hutchins Jun. 1987 119 p
(AD-A184129) Avail: NTIS HC A06/MF A01 CSCL 06J

This study investigated the relationship of Schonpflug's model of regulatory behavior and a questionnaire which was designed to assess behavioral change due to fatigue in aviation crew members. Data was gathered from three patrol aviation squadrons. Rotated factor analysis was used to determine designation of factors and their related questions. A paired sample t-test was utilized for the determination of change due to a one month period of flight operations. The two statistical tests were graphically combined and compared to Schonopflug's model of regulatory behavior. The psychological costs to benefits economics of Schonpflug's regulatory model were confirmed. Schonpflug's model was found to be an excellent evaluative tool when coupled with the questionnaire's statistical tests in determining non resolution of problems brought about by fatigue. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-12246*# Psycho-Linguistic Research Associates, Menlo Park, Calif.
INTEGRATED VOICE AND VISUAL SYSTEMS RESEARCH TOPICS
Douglas H. Williams and Carol A. Simpson Jun. 1986 6 p
(Contract NAS2-11341)
(NASA-CR-177417; NAS 1.26:177417) Avail: NTIS HC A02/MF A01 CSCL 17B

A series of studies was performed to investigate factors of helicopter speech and visual system design and measure the

effects of these factors on human performance, both for pilots and non-pilots. The findings and conclusions of these studies were applied by the U.S. Army to the design of the Army's next generation threat warning system for helicopters and to the linguistic functional requirements for a joint Army/NASA flightworthy, experimental speech generation and recognition system. Author

N88-12247# European Space Agency, Paris (France).
INVESTIGATION OF PILOT BEHAVIOR IN A TRAINING PROGRAM FOR ASSESSING HANDLING QUALITIES USING A GROUND SIMULATOR
Dietrich Altenkirch Sep. 1987 40 p Transl. into ENGLISH of Untersuchung des Pilotenverhaltens im Rahmen eines Trainingsprogrammes im Bodensimulator zur Flugeigenschaftsbeurteilung (Brunswick, Federal Republic of Germany) Original language document was previously announced as N86-32975.
(ESA-TT-999; DFVLR-Mitt-86-01; ETN-87-91111) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 15.50

A pilot training session for rating handling qualities of transport aircraft was conducted with four test pilots by using a moving cockpit ground simulator. Each pilot flew three tasks take-off/climb, cruise/landing, approach/touchdown. In addition to the basic version of the aircraft, the pilots rated the handling qualities of two configurations differing in dynamics and control modes. Cooper-Harper pilot ratings and special effort ratings, as well as statistical values computed from measured performance data of the pilot/aircraft system are presented as a function of the configuration and turbulence levels. ESA

N88-12248*# California Univ., Irvine. Program in Social Ecology.
HUMAN ADAPTATION TO ISOLATED AND CONFINED ENVIRONMENTS Final Report, Apr. 1985 - Jul. 1987
Gary W. Evans, Daniel Stokols, and Sybil Carrere 10 Dec. 1987 141 p
(Grants NAG2-387; NSF DPP-86-08969)
(NASA-CR-181502; NAS 1.26:181502) Avail: NTIS HC A07/MF A01 CSCL 05I

A study was conducted over seven months in a winter Antarctic isolated and confined environment (ICE). Physiological and psychological data was collected several times a week. Information was collected on a monthly basis on behavior and the use of physical facilities. Adaptation and information indicated that there was a significant decrease in epinephrine and norepinephrine during the middle trimester of the winter. No vital changes were found for blood pressure. Self reports of hostility and anxiety show a linear increase. There were no significant changes in depression during ICE. The physiological and psychological data do not move in a synchronous fashion over time. The data also suggest that both ambient qualities of an ICE and discrete social environmental events, such as the arrival of the summer crew, have an impact on the outcome measures used. It may be most appropiate to develop a model for ICE's that incorporates not only global chronic stressors common to all ICE's but also the role of discrete environmental effects which can minimize or enhance the influence of more chronic stressors. Behavioral adjustment information highlight the importance of developing schedules which balance work and recreational activities. Author

N88-12249# Washington Univ., Seattle. Dept. of Psychology.
COMPUTER-CONTROLLED TESTING OF VISUAL-SPATIAL ABILITY Final Report, Jan. 1985 - Jan. 1986
Earl Hunt, James W. Pellegrino, Ronald Abate, David L. Alderton, and Simon A. Farr Aug. 1987 49 p Prepared in cooperation with California Univ., Santa Barbara
(Contract N66001-85-C-0017; F63-521)
(AD-A183971; Rept-91-6001-537; NPRDC-TR-87-31) Avail: NTIS HC A03/MF A01 CSCL 05I

Identifying people who have high spatial-visual ability would facilitate the assignment of individuals to occupations where success depends on these skills. The major facilitation would be expected for jobs requiring machinery operations and/or the reading of analog displays and diagrams. Traditionally, spatial-visual ability is tested by asking people to reason about pictures presented in a conventional paper-and-pencil format. Computer-controlled testing makes it possible to make much finer measures of how people reason about a visual scene, and to measure reasoning about absolute and relative motion. The purpose is to (1) develop tests of spatial-visual reasoning based on computer technology, (2) determine if these tests measure any dimensions of spatial-visual ability not measured by current tests, and (3) provide these new tests to the Navy for further investigation as personnel classification tools. Eleven computer-administered tasks requiring spatial-visual ability were developed. Six of these took advantage of the computer's ability to present moving objects. Five took advantage of the computer's ability to measure reaction time for individual problems. These tasks and eight conventional paper and pencil tests were given to 170 college students. Scores were correlated, and multivariate factor analyses were conducted. GRA

N88-12250# Washington Univ., St. Louis, Mo. Dept. of Neurology.
EFFECTS OF DIVIDED ATTENTION ON IDENTITY AND SEMANTIC PRIMING
Jennifer Sandson and Michael I. Posner 1987 41 p
(Contracts N00014-86-K-0289; DA Proj. RR0-4206)
(AD-A184289; TR-87-6-ONR) Avail: NTIS HC A03/MF A01 CSCL 05H

According to some models of lexical access visual information can directly activate semantic memory. Priming can be obtained from stimuli that are either physically identical or semantically related to the target. Studies show that identity priming is not reduced by performance of a simultaneous auditory shadowing task. The strength of identity priming does not vary between conditions in which the relatedness of the prime provides information about the correct response (lexical decision) and conditions in which it does not (semantic classification). On the other hand, semantic priming is reduced during shadowing with lexical decision and in semantic classification. These data suggest that identity primes operate upon a visual code of the input that is not influenced by simultaneous auditory processing while semantic priming involves a system to which both auditory and visual information have access. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-12251*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM: REGENERATIVE LIFE SUPPORT SYSTEMS IN SPACE
Robert D. MacElroy and David T. Smernoff (New Hampshire Univ., Durham.) Sep. 1987 153 p The 26th COSPAR Meeting held in Toulouse, France, Jul. 1986
(Contract NCC2-231)
(NASA-CP-2480; A-87256; NAS 1.55:2480) Avail: NTIS HC A08/MF A01 CSCL 06K

A wide range of topics related to the extended support of humans in space are covered. Overviews of research conducted in Japan, Europe, and the U.S. are presented. The methods and technologies required to recycle materials, especially respiratory gases, within a closed system are examined. Also presented are issues related to plant and algal productivity, efficiency, and processing methods. Computer simulation of closed systems, discussions of radiation effects on systems stability, and modeling

of a computer bioregenerative system are also covered. For individual titles, see N88-12252 through N88-12273.

N88-12252*# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PROGRESS IN EUROPEAN CELSS ACTIVITIES
A. I. Skoog *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 1-4 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

The European Controlled Ecological Life Support System (CELSS) activities started in the late 1970's with system analysis and feasibility studies of Biological Life Support Systems (BLSS). The initiation for CELSS came from the industry side in Europe, but since then planning and hardware feasibility analyses have been initiated also from customer/agency side. Despite this, it is still too early to state that a CELSS program as a concerted effort has been agreed upon in Europe. However, the general CELSS objectives were accepted as planning and possible development goals for the European effort for manned space activities, and as experimental planning topics in the life sciences community for the next decades. It is expected that ecological life support systems can be tested and implemented on a space station towards the end of this century or early in the next. For the European activities a possible scenario can be projected based on ongoing life support system development activities and the present life sciences goals. Author

N88-12253*# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.
FOOD PRODUCTION AND GAS EXCHANGE SYSTEM USING BLUE-GREEN ALGA (SPIRULINA) FOR CELSS
Mitsuo Oguchi, Koji Otsubo, Keiji Nitta, and Shigeki Hatayama *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 5-8 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

In order to reduce the cultivation area required for the growth of higher plants in space adoption of algae, which have a higher photosynthetic ability, seems very suitable for obtaining oxygen and food as a useful source of high quality protein. The preliminary cultivation experiment for determining optimum cultivation conditions and for obtaining the critical design parameters of the cultivator itself was conducted. Spirulina was cultivated in the 6 liter medium containing a sodium hydrogen carbonate solution and a cultivation temperature controlled using a thermostat. Generated oxygen gas was separated using a polypropyrene porous hollow fiber membrane module. Through this experiment, oxygen gas (at a concentration of more than 46 percent) at a rate of 100 to approx. 150 ml per minute could be obtained. Author

N88-12254*# Martek Corp., Columbia, Md.
BIOMASS RECYCLE AS A MEANS TO IMPROVE THE ENERGY EFFICIENCY OF CELSS ALGAL CULTURE SYSTEMS
R. Radmer, J. Cox, D. Lieberman, P. Behrens, and K. Arnett *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 9-13 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Algal cultures can be very rapid and efficient means to generate biomass and regenerate the atmosphere for closed environmental life support systems. However, as in the case of most higher plants, a significant fraction of the biomass produced by most algae cannot be directly converted to a useful food product by standard food technology procedures. This waste biomass will serve as an energy drain on the overall system unless it can be efficiently recycled without a significant loss of its energy content. Experiments are reported in which cultures of the alga Scenedesmus obliquus were grown in the light and at the expense of an added carbon source, which either replaced or supplemented the actinic light. As part of these experiments, hydrolyzed waste biomass from these same algae were tested to determine whether the algae themselves could be made part of the biological recycling process. Results indicate that hydrolyzed algal (and plant) biomass can serve as carbon and energy sources for the growth of these algae, suggesting that the efficiency of the closed system could be significantly improved using this recycling process. Author

N88-12255*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OPERATION OF AN EXPERIMENTAL ALGAL GAS EXCHANGER FOR USE IN A CELSS
David T. Smernoff, Robert A. Wharton, Jr., and Maurice M. Averner (National Aeronautics and Space Administration, Washington, D.C.) *In its* Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 15-25 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Concepts of a Closed Ecological Life Support System (CELSS) anticipate the use of photosynthetic organisms (higher plants and algae) for air revitalization. The rates of production and uptake of carbon dioxide and oxygen between the crew and the photosynthetic organisms are mismatched. An algal system used for gas exchange only will have the difficulty of an accumulation or depletion of these gases beyond physiologically tolerable limits (in a closed system the mismatch between assimilatory quotient (AQ) and respiratory quotient (RQ) is balanced by the operation of the waste processor). The results are given of a study designed to test the feasibility of using environmental manipulations to maintain physiologically appropriate atmospheres for algae and mice in a gas closed system. Specifically, the atmosphere behavior of this system is considered with algae grown on nitrate or urea and at different light intensities and optical densities. Manipulation of both allow operation of the system in a gas stable manner. Operation of such a system in a CELSS may be useful for reduction of buffer sizes, as a backup system for higher plant air revitalization and to supply extra oxygen to the waste processor or during crew changes. Author

N88-12256*# Massachusetts Inst. of Tech., Cambridge.
NON-CONVENTIONAL APPROACHES TO FOOD PROCESSING IN CELSS, 1. ALGAL PROTEINS: CHARACTERIZATION AND PROCESS OPTIMIZATION
Z. Nakhost, M. Karel, and V. J. Krukonis (Phasex Corp., Lawrence, Mass.) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 27-36 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Protein isolate obtained from green algae cultivated under controlled conditions was characterized. Molecular weight determination of fractionated algal proteins using SDS-polyacrylamide gel electrophoresis revealed a wide spectrum of molecular weights ranging from 15,000 to 220,000. Isoelectric points of dissociated proteins were in the range of 3.95 to 6.20. Amino acid composition of protein isolate compared favorably with FAO standards. High content of essential amino acids leucine, valine, phenylalanine and lysine make algal protein isolate a high quality component of closed ecological life support system diets. To optimize the removal of algal lipids and pigments supercritical carbon dioxide extraction (with and without ethanol as a co-solvent) was used. Addition of ethanol to supercritical carbon dioxide resulted in more efficient removal of algal lipids and produced protein isolate with a good yield and protein recovery. The protein isolate extracted by the above mixture had an improved water solubility. Author

N88-12257*# California Univ., Berkeley. Lawrence Berkeley Lab. Bioenergetics Group.
APPLICATION OF PHOTOSYNTHETIC N(2)-FIXING CYANOBACTERIA TO THE CELSS PROGRAM
Ian V. Fry, Jana Hrabeta, Joe DSouza (Goa Univ., India), and Lester Packer *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems

in Space Sep. 1987 p 37-41 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

The feasibility of using photosynthetic microalgae (cyanobacteria) as a subsystem component for the closed ecological life support system program, with particular emphasis on the manipulation of the biomass (protein/carbohydrate) was addressed. Using factors which retard growth rates, but not photosynthetic electron flux, the partitioning of photosynthetically derived reductant may be dictated towards CO2 fixation (carbohydrate formation) and away from N2 fixation (protein formation). Cold shock treatment of fairly dense cultures markedly increases the glycogen content from 1 to 35 percent (dry weight), and presents a useful technique to change the protein/carbohydrate ratio of these organisms to a more nutritionally acceptable form. Author

N88-12258*# Keio Univ., Yokahama (Japan).
SUNLIGHT SUPPLY AND GAS EXCHANGE SYSTEMS IN MICROALGAL BIOREACTOR
K. Mori, H. Ohya, K. Matsumoto, and H. Furune (La Foret Engineering and Information Service Co., Tokyo, Japan) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 45-50 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

The bioreactor with sunlight supply system and gas exchange systems presented has proved feasible in ground tests and shows much promise for space use as a closed ecological life support system device. The chief conclusions concerning the specification of total system needed for a life support system for a man in a space station are the following: (1) Sunlight supply system - compactness and low electrical consumption; (2) Bioreactor system - high density and growth rate of chlorella; and (3) Gas exchange system - enough for O2 production and CO2 assimilation. Author

N88-12259*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A REVIEW OF RECENT ACTIVITIES IN THE NASA CELSS PROGRAM
R. D. MacElroy, J. Tremor, D. T. Smernoff, W. Knott, and R. P. Prince (National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.) *In its* Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 51-55 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

A CELSS (Controlled Ecological Life Support System) is a device that utilizes photosynthetic organisms and light energy to regenerate waste materials into oxygen and food for a crew in space. The results of studies with the CELSS program suggest that a bioregenerative life support system is a useful and effective method of regenerating consumable materials for crew sustenance. The data suggests that the operation of a CELSS in space is practical if plants can be made to behave predictably in the space environment. Much of the work centers on the biological components of the CELSS system. Ways of achieving high efficiency and long term stability of all components of the system are examined. Included are explorations of the conversion of nonedible cellulose to edible materials, nitrogen fixation by biological and chemical methods, and methods of waste processing. A description is provided of the extent to which a bioregenerative life support system can meet the constraints of the space environment, and the degree is assessed to which system efficiency and stability can be increased during the next decade. Author

N88-12260*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MODULAR BLSS SIMULATION MODEL
John D. Rummel and Tyler Volk (New York Univ., New York.) *In its* Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 57-65 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

A bioregenerative life support system (BLSS) for extraterrestrial use will be faced with coordination problems more acute than those in any ecosystem found on Earth. A related problem in BLSS design is providing an interface between the various life support processors, one that will allow for their coordination while still allowing for system expansion. A modular model is presented of a BLSS that interfaces system processors only with the material storage reservoirs, allowing those reservoirs to act as the principal buffers in the system and thus minimizing difficulties with processor coordination. The modular nature of the model allows independent development of the detailed submodels that exist within the model framework. Using this model, BLSS dynamics were investigated under normal conditions and under various failure modes. Partial and complete failures of various components, such as the waste processors or the plants themselves, drive transient responses in the model system, allowing the examination of the effectiveness of the system reservoirs as buffers. The results from simulations help to determine control strategies and BLSS design requirements. An evolved version could be used as an interactive control aid in a future BLSS. Author

N88-12261*# Mitsubishi Heavy-Industries Ltd., Nagoya (Japan).
PRELIMINARY EXPERIMENTAL RESULTS OF GAS RECYCLING SUBSYSTEMS EXCEPT CARBON DIOXIDE CONCENTRATION
K. Otsuji, T. Sawada, S. Satoh, S. Kanda, H. Matsumura, S. Kondo, and K. Otsubo (National Aerospace Lab., Tokyo, Japan) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 67-70 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Oxygen concentration and separation is an essential factor for air recycling in a controlled ecological life support system (CELSS). Furthermore, if the value of the plant assimilatory quotient is not coincident with that of the animal respiratory quotient, the recovery of oxygen from the concentrated CO2 through chemical methods will become necessary to balance the gas contents in a CELSS. Therefore, oxygen concentration and separation equipment using Salcomine and O2 recovery equipment, such as Sabatier and Bosch reactors, were experimentally developed and tested. Author

N88-12262*# Hitachi Ltd., Tokyo (Japan). Space Systems Div.
VAPOR COMPRESSION DISTILLER AND MEMBRANE TECHNOLOGY FOR WATER REVITALIZATION
A. Ashida, K. Mitani, K. Ebara, H. Kurokawa, I. Sawada, H. Kashiwagi, T. Tsuji, S. Hayashi, K. Otsubo, and K. Nitta (National Aerospace Lab., Tokyo, Japan) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 71-74 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Water revitalization for a space station can consist of membrane filtration processes and a distillation process. Water recycling equipment using membrane filtration processes was manufactured for ground testing. It was assembled using commercially available components. Two systems for the distillation are studied: one is absorption type thermopervaporation cell and the other is a vapor compression distiller. Absorption type thermopervaporation, able to easily produce condensed water under zero gravity, was investigated experimentally and through simulated calculation. The vapor compression distiller was studied experimentally and it offers significant energy savings for evaporation of water. Author

N88-12263*# Science Univ. of Tokyo, Chiba (Japan).
FUNDAMENTAL STUDY ON GAS MONITORING IN CELSS
I. Nishi, T. Tateishi, G. Tomizawa, K. Nitta, and M. Oguchi (National Aerospace Lab., Tokyo, Japan) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 75-78 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

A mass spectrometer and computer system was developed for conducting a fundamental study on gas monitoring in a Controlled Ecological Life Support System. Respiration and metabolism of the hamster and photosynthesis of the Spirulina were measured in a combination system consisting of a hamster chamber and a Spirulina cultivator. They are connected through a membrane gas exchanger. Some technical problems were examined. In the mass spectrometric gas monitoring, a simultaneous multisample measurement was developed by employing a rotating exchange valve. Long term precise measurement was obtained by employing an automatic calibration system. The membrane gas sampling probe proved to be useful for long term measurement. The cultivation rate of the Spirulina was effectively changed by controlling CO2 and light supply. The experimental results are helpful for improving the hamster-spirulina system. Author

N88-12264*# Niigata Univ. (Japan). Dept. of Civil Engineering.
THE APPLICABILITY OF THE CATALYTIC WET-OXIDATION TO CELSS
Y. Takahashi, K. Nitta, H. Ohya, and M. Oguchi (National Aerospace Lab., Tokyo, Japan) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 79-82 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

The wet oxidation catalysis of Au, Pd, Pt, Rh or Ru on a ceramic honeycomb carrier was traced in detail by 16 to 20 repetitive batch tests each. As a result, Pt or Pd on a honeycomb carrier was shown to catalyze complete nitrogen gasification as N2. Though the catalysts which realize both complete nitrogen gasification and complete oxidation could not be found, the Ru+Rh catalyst was found to be most promising. Ru honeycomb catalyzed both nitrification and nitrogen gasification. Author

N88-12265*# Mitsubishi-Kasei Inst. of Life Sciences, Tokyo (Japan). Lab. of Biogeochemistry and Sociogeochemistry.
A LARGE-SCALE PERSPECTIVE ON ECOSYSTEMS
Hiroshi Mizutani *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 83-86 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Interactions between ecological elements must be better understood in order to construct an ecological life support system in space. An index was devised to describe the complexity of material cyclings within a given ecosystem. It was then applied to the cyclings of bioelements in various systems of material cyclings including the whole Earth and national economies. The results show interesting characteristics of natural and man-made systems. Author

N88-12266*# California Univ., Davis. Plant Growth Lab.
DESIGN OF AN ELEMENTAL ANALYSIS SYSTEM FOR CELSS RESEARCH
Steven H. Schwartzkopf *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 87-91 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

The results of experiments conducted with higher plants in tightly sealed growth chambers provide definite evidence that the physical closure of a chamber has significant effects on many aspects of a plant's biology. One of these effects is seen in the change in rates of uptake, distribution, and re-release or nutrient elements by the plant (mass balance). Experimental data indicates that these rates are different from those recorded for plants grown in open field agriculture, or in open growth chambers. Since higher plants are a crucial component of a controlled ecological life support system (CELSS), it is important that the consequences of these rate differences be understood with regard to the growth and yield of the plants. A description of a system for elemental analysis which can be used to monitor the mass balance of nutrient elements in CELSS experiments is given. Additionally, data on the uptake of nutrient elements by higher plants grown in a growth chamber is presented. Author

N88-12267*# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.
AN OVERVIEW OF JAPANESE CELSS RESEARCH ACTIVITIES
Keiji Nitta *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 93-101 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Development of Controlled Ecological Life Support System (CELSS) technology is inevitable for future long duration stays of human beings in space, for lunar base construction and for manned Mars flight programs. CELSS functions can be divided into 2 categories, Environmental Control and Material Recycling. Temperature, humidity, total atmospheric pressure and partial pressure of oxygen and carbon dioxide, necessary for all living things, are to be controlled by the environment control function. This function can be performed by technologies already developed and used as the Environment Control Life Support System (ECLSS) of Space Shuttle and Space Station. As for material recycling, matured technologies have not yet been established for fully satisfying the specific metabolic requirements of each living thing including human beings. Therefore, research activities for establishing CELSS technology should be focused on material recycling technologies using biological systems such as plants and animals and physico-chemical systems, for example, a gas recycling system, a water purifying and recycling system and a waste management system. Japanese research activities were conducted and will be continued accordingly. Author

N88-12268*# Commissariat a l'Energie Atomique, Cadarache (France). Service de Radioagronomie.
STUDY OF THE RELATIONSHIP BETWEEN PHOTOSYNTHESIS, RESPIRATION, TRANSPIRATION, AND MINERAL NUTRITION IN WHEAT [ETUDE DES RELATIONS ENTRE PHOTOSYNTHESE RESPIRATION TRANSPIRATION ET NUTRITION MINERALE CHEZ LE BLE]
M. Andre, H. Ducloux, C. Richaud, D. Massimino, A. Daguenet, J. Massimino, and A. Gerbaud (Institut National de la Recherche Agronomique, Thiverval-Grignon, France) *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 103-112 In FRENCH (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

The growth of wheat (triticum aestivum) was studied in an enclosed controlled environment for a period of 70 days. The exchange of gases (photosynthesis, respiration), water (transpiration) and the consumption of mineral elements (nitrogen, phosphorus, potassium) were continuously measured. The dynamical relations observed in the different physiological functions, under the influence of growth and in response to environment modifications are presented. The influence of carbon dioxide content during growth (normal or double percentage) was made clear. Author

N88-12269*# Wisconsin Univ., Madison. Dept. of Horticulture.
UTILIZATION OF POTATOES IN BIOREGENERATIVE LIFE SUPPORT SYSTEMS
T. W. Tibbitts and R. M. Wheeler *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 113-120 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Data on the tuberization, harvest index, and morphology of 2 cvs of white potato (Solanum tuberosum L.) grown at 12, 16, 20, 24 and 28 C, 250, 400 and 550 micromol/s/m photosynthetic photon flux (PPF), 350, 1000 and 1600 microliter 1 sup -1 CO2 is presented. A productivity of 21.9 g/m day sup -1 of edible tubers

from a solid stand of potatoes grown for 15 weeks with continuous irradiation at 400 micromol/s/m, 16 C and 1000 microliter 1 sup -1 CO2 was obtained. This equates to an area of 34.3 sq m being required to provide 2800 kcal of potatoes per day for a human diet. Separated plants receiving side lighting have produced 32.8 g/m day sup -1 which equates to an area of 23.6 sq m to provide 2800 kcal. Studies with side lighting indicate that productivities in this range should be realized from potatoes. Glycoalkaloid levels in tubers of controlled environment grown plants are within the range of levels found in tubers of field grown plants. The use and limitation of recirculating solution cultures for potato growth is discussed. Author

N88-12270*# Utah State Univ., Logan. Dept. of Plant Science.
WHEAT PRODUCTION IN CONTROLLED ENVIRONMENTS
Frank B. Salisbury, Bruce Bugbee, and David Bubenheim *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 121-130 Sponsored in part by Utah Agricultural Experiment Station, Logan (For primary document see N88-12251 03-54)
(Contract NCC2-139)
(UAES-Paper-3324) Avail: NTIS HC A08/MF A01 CSCL 06K

Conditions are optimized for maximum yield and quality of wheat to be used in a controlled environment life support system (CELSS) in a Lunar or Martian base or a spacecraft. With yields of 23 to 57 g/sq m/d of edible biomass, a minimum size for a CELSS would be between 12 and 30 sq m per person, utilizing about 600 W/sq m of electrical energy for artificial light. Temperature, irradiance, photoperiod, carbon dioxide levels, humidity, and wind velocity are controlled in growth chambers. Nutrient solutions (adjusted for wheat) are supplied to the roots via a recirculating system that controls pH by adding HNO3 and controlling the NO3/NH4 ratio in solution. A rock-wool plant support allows direct seeding and densities up to 10,000 plants sq m. Densities up to 2000 plants/sq m appear to increase seed yield. Biomass production increases almost linearly with increasing irradiance from 400 to 1700 micromol/sq m/s of photosynthetic photon flux, but the efficiency of light utilization decreases over this range. Photoperiod and temperature both have a profound influence on floral initiation, spikelet formation, stem elongation, and fertilization. Author

N88-12271*# Alberta Research Council, Edmonton (Canada). Dept. of Biotechnology.
THE EFFECT OF RADIATION ON THE LONG TERM PRODUCTIVITY OF A PLANT BASED CELSS
B. G. Thompson (New York Univ., New York.) and B. H. Lake *In* NASA, Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support System in Space Sep. 1987 p 131-138 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Mutations occur at a higher rate in space than under terrestrial conditions, primarily due to an increase in radiation levels. These mutations may effect the productivity of plants found in a controlled ecological life support system (CELSS). Computer simulations of plants with different ploidies, modes of reproduction, lethality thresholds, viability thresholds and susceptibilities to radiation induced mutations were performed under space normal and solar flare conditions. These simulations identified plant characteristics that would enable plants to retain high productivities over time in a CELSS. Author

N88-12272*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MASS BALANCES FOR A BIOLOGICAL LIFE SUPPORT SYSTEM SIMULATION MODEL
Tyler Volk (New York Univ., New York.) and John D. Rummel *In its* Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 139-146 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Design decisions to aid the development of future space based biological life support systems (BLSS) can be made with simulation models. The biochemistry stoichiometry was developed for: (1) protein, carbohydrate, fat, fiber, and lignin production in the edible and inedible parts of plants; (2) food consumption and production of organic solids in urine, feces, and wash water by the humans; and (3) operation of the waste processor. Flux values for all components are derived for a steady state system with wheat as the sole food source. The large scale dynamics of a materially closed (BLSS) computer model is described in a companion paper. An extension of this methodology can explore multifood systems and more complex biochemical dynamics while maintaining whole system closure as a focus. Author

N88-12273*# Meijo Univ., Nagoya (Japan).
TRICKLE WATER AND FEEDING SYSTEM IN PLANT CULTURE AND LIGHT-DARK CYCLE EFFECTS ON PLANT GROWTH
T. Takano, K. Inada, and J. Takanashi (National Inst. of Agrobiological Resources, Ibaraki, Japan) *In* NASA- Ames Research Center, Controlled Ecological Life Support System: Regenerative Life Support Systems in Space Sep. 1987 p 147-150 (For primary document see N88-12251 03-54)
Avail: NTIS HC A08/MF A01 CSCL 06K

Rockwool, as an inert medium covered or bagged with polyethylene film, can be effectively used for plant culture in space stations. The most important machine is the pump adjusting the dripping rate in the feeding system. Hydro-aeroponics may be adaptable to a space laboratory. The shortening of the light-dark cycles inhibits plant growth and induces an abnormal morphogenesis. A photoperiod of 12 hr dark may be needed for plant growth. Author

N88-12274 Civil Aviation Authority, London (England).
REPORT OF THE HELICOPTER HUMAN FACTORS WORKING GROUP
1987 29 p
(CAA-Paper-87007; ISBN-0-86039-312-7; ETN-87-90962)
Copyright Avail: Issuing Activity

The extent to which incidents and accidents to helicopters were due wholly or in part to human factor causes was evaluated. Steps to be taken, within the limits of current technology, to minimize or eliminate these causes are suggested. ESA

N88-12275# State Univ. of New York at Buffalo, Amherst. Dept. of Industrial Engineering.
HUMAN MOTOR REACTIONS TO DANGEROUS MOTIONS IN ROBOT OPERATIONS
M. G. Helander and M. H. Karwan Mar. 1987 48 p Sponsored by National Inst. for Occupational Safety and Health, Morgantown, W. Va.
(PB87-222196) Avail: NTIS HC A03/MF A01 CSCL 05H

In order to increase the safety factor for human workers who must work in conjunction with robots, a study was performed to analyze a robotic operation at a factory and use this analysis to propose a model containing factors which contribute to potential safety problems, such as being struck by a robot element or tooling or being caught in a pinch point. The study was also designed to develop a mathematical model relating robot speed and human reaction time to risk of injury by the robot. The site of the visit was a manufacturing company using an arc welding robot. Later two additional robots were added to the work force. Two were hydraulic and one an electromechanical version of the other two. The robots were to perform arc welding of steel frames for cabinets for computers. There were about 30 welds per frame. The productivity rate using these robots increased three to four times compared to manual welding. In the robot workplace there were three different types of jobs: the robot operator, the millwright, and the electrician. Factors which influenced the robotic safety included speed of robot arm movement, design of the teach pendant, and movement pattern of the robot. The current workplace lacked safety devices such as safety gates, floor mats, or lockout procedures. GRA

N88-12276# California Univ., San Diego. Dept. of Applied Mechanics and Engineering Sciences.
OPERATOR MULTIPLE-TASKING STUDY FOR REMOTELY OPERATED PLATFORMS Final Report, Oct. 1985 - Aug. 1986
K. S. Haaland and D. D. Sworder Apr. 1987 100 p
(Contract N66001-85-D-0203; C12-134)
(AD-A184487; NOSC-TD-1084) Avail: NTIS HC A05/MF A01
CSCL 05H

This report provides the equations of evolution of an encounter involving a teleoperated vehicle. The global model contains interconnected submodels describing the conventional external primitives of the encounter (base states), suddenly occurring events (feature states), and a dynamic description of the remote operator (the generalized operator model). This model is phrased as a set of stochastic differential equations that can accommodate both linear and nonlinear effects. The final section of the report places these results within the context of the multitask problem, and indicates the direction of future research which will yield a quantitative description of vehicle performance in a rapidly changing environment. GRA

N88-12277# Oak Ridge National Lab., Tenn.
ARCHITECTURE FOR DYNAMIC TASK ALLOCATION IN A MAN-ROBOT SYMBIOTIC SYSTEM
L. E. Parker and F. G. Pin 1987 14 p Presented at the SPIE Cambridge Symposium on Intelligent Robots and Computer Vision, Cambridge, Mass., 1 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE87-013872; CONF-871163-2) Avail: NTIS HC A02

Presented is a methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation. This paper addresses a symbiosis containing two partners working toward controlling a single manipulator arm for the execution of a series of sequential manipulation subtasks. The proposed automated task allocator uses knowledge about the allocation policies of the problem, the available resources, and the tasks to be performed to dynamically allocate tasks to the man and the machine. DOE

N88-12278# California Univ., Berkeley. Lawrence Berkeley Lab.
A SCIENTIFIC WORKSTATION OPERATOR-INTERFACE FOR ACCELERATOR CONTROL
V. Paxson, V. Jacobson, E. Theil, M. Lee, and S. Clearwater 23 Apr. 1987 14 p Presented at the Particle Accelerator Conference, Washington, D.C., 16 Mar. 1987
(Contract DE-AC03-76SF-00098)
(DE87-014689; LBL-23206; CONF-870302-249) Avail: NTIS HC A03/MF A01

Research in human factors has demonstrated that people use computers more efficiently and effectively if they have a highly visual interface to the machine. Today's scientific workstations provide sufficient power to implement such interfaces. By using these workstations, an operator interface for an accelerator control system can be built which is powerful, flexible, and easy to learn. We discuss such a system currently being developed on a Sun-3 workstation. The system is designed as a set of building blocks (e.g., Working Diagram,Twiss Plot, Beamline, Orbit Correction) which can be run independently or linked together. This toolbox approach gives the operator the ability to execute precisely those programs needed for the task at hand. Each program runs in a separate window and communicates with other running programs via a common data base. When the operator makes a change in one window, the effects are then shown in the other windows. For example, to change the tune of the machine while monitoring beam scraping, the operator activates the Working Diagram and Beam Position tools. The operator points to the new tune on the working diagram window and sees the effects it would have on the beam profile in the other window. DOE

N88-12279# Naval Postgraduate School, Monterey, Calif.
A SIMULATION STUDY OF A SPEED CONTROL SYSTEM FOR AUTONOMOUS ON-ROAD OPERATION OF AUTOMOTIVE VEHICLES M.S. Thesis
Michael J. Dolezal Jun. 1987 270 p
(Contract MIPR-ATEC-88-86)
(AD-A184030; NPS52-87-020) Avail: NTIS HC A12/MF A01
CSCL 17G

The study of human driving of automotive vehicles is an important aid to the development of viable autonomous vehicle navigation and control techniques. Observation of human behavior during driving suggests that this activity involved two distinct levels, the conscious and the unconscious. The behavior of a driver while stopping his vehicle at a stop sign can be conscious or unconscious, depending on the driver's skill level and the driving conditions. The driver's behavior involves a difficult process of estimating the distance to the stop sign and the velocity of the vehicle. Using these estimates, the driver then takes the necessary control actions to stop the vehicle. This research attempts to mimic the driver's conscious and unconscious behavior through mathematical modeling and computer simulation. GRA

N88-11668# Royal Netherlands Air Force, The Hague.
DEVELOPMENT, TESTING AND EVALUATION OF A NIGHT VISION GOGGLE COMPATIBLE BO-105 FOR NIGHT LOW LEVEL OPERATION
R. H. Friedericy *In* AGARD, Rotorcraft Design for Operations Jun. 1987 8 p (For primary document see N88-11649 03-05)
Avail: NTIS HC A14/MF A01

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-12280# Lawrence Livermore National Lab., Calif.
THE MACINTOSH COMPUTER AS A TOOL FOR RAPID DATA ANALYSIS AND FOR PRODUCING CAMERA READY VIEWGRAPHS/PUBLICATIONS
J. M. Beiriger Aug. 1987 5 p Presented at the 33rd Annual Bioassay Analytical and Environmental Radiochemistry Conference, Livermore, Calif., 6 Oct. 1987
(Contract W-7405-eng-48)
(DE87-014350; UCRL-96707; CONF-871061-2) Avail: NTIS HC A02/MF A01

The graphics capability of the Macintosh computer has been

utilized for plotting of experimental data for analysis. The Macintosh has also been used in producing viewgraphs. DOE

N88-12281# European Space Agency, Paris (France).
A DIGITAL LOW PASS FILTER FOR THE REDUCTION OF LARGE QUANTITIES OF DATA
Ruthard Koehler Jul. 1987 22 p Transl. into ENGLISH of Ein Digitales Tiefpassfilter zur Reduzierung Grosser Datenmengen (Brunswick, Federal Republic of Germany) Original language document was previously announced as N87-26269
(ESA-TT-1058; DFVLR-FB-86-49; ETN-87-91124) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 11.50

Digital low pass filters were developed in order to avoid folding errors due to the increase of the sampling interval. Coefficients for symmetric low pass filters for doubling the sampling intervals were calculated. If the application of filtering and doubling of sampling intervals is repeated several times, low pass filter designs using fewer data points are required for initial filtering. The filter coefficients were calculated from the analytical solution of a cost function which includes the errors of the transfer function. These errors were weighted depending on the frequency. ESA

N88-12282# National Bureau of Standards, Gaithersburg, Md. Advanced Systems Div.
HARDWARE-ASSISTED MULTIPROCESSOR PERFORMANCE MEASUREMENTS
J. W. Roberts, A. Mink, J. M. Draper, and R. J. Carpenter Jun. 1987 16 p Sponsored by DARPA, Arlington, Va.
(PB87-226908; NBSIR-87/3585) Avail: NTIS HC A03/MF A01 CSCL 09B

The implementation and use of a hardware-assisted trace measurement system (TRAMS) used to obtain performance measurements of parallel cooperating processes executing on a multiprocessor computer are described. The benefit of TRAMS is that the overhead required to obtain timing information is approximately two orders of magnitude better than the standard system call, thus providing more accurate results with minimum perturbation to the measured processes. The level of accuracy allows measurement of fine-grain portions of these parallel processes which cannot be reasonably measured using standard techniques, and are therefore usually presented as negligible. Some measurements that were obtained using TRAMS on a tightly-coupled, shared-memory parallel processor are reported here and include basic programming constructs, process creation, process synchronization, and shared memory allocation. GRA

N88-12283# Naval Postgraduate School, Monterey, Calif.
DESIGN AND IMPLEMENTATION OF A DEBUGGER FOR AN ABSTRACT MACHINE M.S. Thesis
Stanley Victrum Jun. 1987 138 p
(AD-A184691) Avail: NTIS HC A07/MF A01 CSCL 09B

Conventional computer architectures do not allow us to unambiguously express our intent in a computer program. The combination of artificial data types and resource models force ambiguity and data structure over-loading. For example, the semantics of a stack combine those of an array structure and a last-in-first-out queue, while the entire stack structure is implemented in computer memory as a group of fixed length cells. This and other machine-data type dependencies can markedly hamper software portability. To overcome these obstacles, a means of formally specifying a computing machine's physical resources in an implementation independent way has been proposed. Creating an abstraction of the computer's physical resources in this manner lets the implementor of the specifications clearly determine the intent of programs written for it. This abstraction has come to be known as the Abstract Machine or AM. GRA

N88-12284# Los Alamos National Lab., N. Mex.
FORTRAN COMPILER PERFORMANCE BENCHMARKS FOR THE IBM PERSONAL COMPUTER
J. S. Ballmann and J. F. Wilkerson Feb. 1987 31 p
(Contract W-7405-eng-36)
(LA-10883-MS) Avail: NTIS HC A03/MF A01

The relative performance of various FORTRAN compilers is measured. The AT and XT models of the IBM personal computer using the PC-DOS operating system were used to evaluate three currently available compilers. Results are summarized and the characteristics of each compiler presented. Author

N88-12285# Los Alamos National Lab., N. Mex.
LOS ALAMOS NATIONAL LABORATORY COMPUTER BENCHMARKING 1986
Margaret L. Simmons and Harvey J. Wasserman Jan. 1987 20 p
(Contract W-7405-eng-36)
(LA-10898-MS) Avail: NTIS HC A03/MF A01

The results of computer performance evaluations as measured by the Computer Research and Applications Group of the Los Alamos National Laboratory are summarized. The benchmarks were conducted between September 1983 and November 1986. Important characteristics of the machines tested are given, and execution times or megaflop rates for a set of portable FORTRAN 77 benchmark codes is included. Tests were performed on the following computers: Cray Research Inc. (CRI) CRAY-1S, X-MP/24, X-MP/48, X-MP/216, X-MP/416, and CRAY-2; Control Data Corporation (CDC) CYBER 825, 855, and 205; Fujitsu VP-200; Hitachi S810/20; NEC SX-2; IBM 3090/200; Digital Equipment Corporation (DEC) VAX 11/780, 11/785, and 8600; and the Convex Computer Corporation C-1. Author

N88-12286# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
THE WARP COMPUTER: ARCHITECTURE, IMPLEMENTATION, AND PERFORMANCE
Marco Annaratone, Emmanuel Arnould, Thomas Gross, H. T. Kung, and Monica Lam Jul. 1987 32 p
(Contracts N00039-85-C-0134; N00014-87-K-0385; N00014-87-K-0533)
(AD-A184329; CMU-RI-TR-87-18) Avail: NTIS HC A03/MF A01 CSCL 09B

The Warps machine is a systolic array computer of linearly connected cells, each of which is a programmable processor capable of performing 10 million floating-point operations per second (10 MFLOPS). A typical Warp array includes 10 cells, thus having a peak computation rate of 100 MFLOPS. The Warp array can be extended to include more cells to accommodate applications capable of using the increased computational bandwidth. Warp is integrated as an attached processor into a UNIX host system. Programs for Warp are written in a high-level language supported by an optimizing compiler. The first 10-cell prototype was completed in February 1986; delivery of production machines started in April 1987. Extensive experimentation with both the prototype and production machines has demonstrated that the Warp architecture is effective in the application domain of robot navigation, as well as in other fields such as signal processing, scientific computation, and computer vision research. For these applications, Warp is typically several hundred times faster than a VAX 11/780 class computer. The architecture, implementation and performance of the Warp machine are described. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-12287* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MAPPING A BATTLEFIELD SIMULATION ONTO MESSAGE-PASSING PARALLEL ARCHITECTURES Final Report

David M. Nicol Oct. 1987 18 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178396; ICASE-87-51; NAS 1.26:178396) Avail: NTIS HC A03/MF A01 CSCL 09B

Perhaps the most critical problem in distributed simulation is that of mapping: without an effective mapping of workload to processors the speedup potential of parallel processing cannot be realized. Mapping a simulation onto a message-passing architecture is especially difficult when the computational workload dynamically changes as a function of time and space; this is exactly the situation faced by battlefield simulations. This paper studies an approach where the simulated battlefield domain is first partitioned into many regions of equal size; typically there are more regions than processors. The regions are then assigned to processors; a processor is responsible for performing all simulation activity associated with the regions. The assignment algorithm is quite simple and attempts to balance load by exploiting locality of workload intensity. The performance of this technique is studied on a simple battlefield simulation implemented on the Flex/32 multiprocessor. Measurements show that the proposed method achieves reasonable processor efficiencies. Furthermore, the method shows promise for use in dynamic remapping of the simulation. Author

N88-12288*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A FORTRAN CODE FOR THE CALCULATION OF PROBE VOLUME GEOMETRY CHANGES IN A LASER ANEMOMETRY SYSTEM CAUSED BY WINDOW REFRACTION
Albert K. Owen (Army Aviation Research and Development Command, Cleveland, Ohio.) Nov. 1987 31 p
(NASA-TM-100210; E-3820; NAS 1.15:100210;
AVSCOM-TR-87-C-27) Avail: NTIS HC A03/MF A01 CSCL 09B

A computer code was written which utilizes ray tracing techniques to predict the changes in position and geometry of a laser Doppler velocimeter probe volume resulting from refraction effects. The code predicts the position change, changes in beam crossing angle, and the amount of uncrossing that occur when the beams traverse a region with a changed index of refraction, such as a glass window. The code calculates the changes for flat plate, cylinder, general axisymmetric and general surface windows and is currently operational on a VAX 8600 computer system. Author

N88-12289# Unisys Corp., Paoli, Pa. Customs Systems Div.
INTEGRATING SYNTAX, SEMANTICS, AND DISCOURSE DARPA (DEFENSE ADVANCED RESEARCH PROJECTS AGENCY) NATURAL LANGUAGE UNDERSTANDING PROGRAM Quarterly Status Report No. 9, 1 May - 31 Jul. 1987
Lynette Hirschman 12 Aug. 1987 7 p
(Contract N00014-85-C-0012)
(AD-A184505) Avail: NTIS HC A02/MF A01 CSCL 09B

Grammar; Syntax/Semantics Interaction; Semantics; Work on Multiple Domains; Environment; Sun Interface; and Port to the Unisys Explorer are discussed. GRA

N88-12290# Space Technology Corp., Fort Collins, Colo.
SBNR (SIGNED BINARY NUMBER REPRESENTATIONS) DIGITAL SIGNAL PROCESSOR ARCHITECTURE Final Technical Report, 1 Sep. 1983 - 30 May 1987
Michael Andrews and David James 31 May 1987 149 p
(Contract DAAG29-83-C-0025)
(AD-A184603; ARO-20192.7-EL-S) Avail: NTIS HC A07/MF A01 CSCL 09B

The following research was proposed in a three-year period. This constitutes significantly distinct efforts which complement the existing efforts in current adaptive signal processor architecture research. Briefly, these tasks comprised a study of non-conventional number system implementations focusing on VSLI enhancements attributable to redundant number systems. This increased practical knowledge should add impetus to many potential signal processing tasks (target trackers, beamformers, communication, receivers, spread spectrum). Three diverse, yet tightly coupled, research topics were posed, centering on the usage of Signed-Digit (SD) arithmetic to solve mult/acc intensive signal processing tasks (streaming data). Efficient implementations for signed-digit arithmetic were sought for systolic arrays. Connectivity and control were investigated for inherent fault-tolerance. Lastly, multiple-valued logic for the Signed Binary Number Representations (SBNR) was studied for both fault-tolerance and array regularity. The dominant and focused application of this research was efficient solutions of specific signal processing algorithms. Author (GRA)

N88-12291# TRADOC Analysis Command, Fort Leavenworth, Kans.
TECHNOLOGY APPLICATIONS BRANCH GRAPHICS PROJECTS Final Report, Apr. - Jul. 1987
Robert H. Kaeding and Tim Daniels Jul. 1987 10 p
(AD-A184621; TRAC-F-TM-0687) Avail: NTIS HC A02/MF A01 CSCL 09B

The Technology Applications Branch-Graphics Team (TAB-GT), Operations Support Directorate, TRADOC Analysis Command (TRAC) is located at Fort Leavenworth, Kansas. TAB-GT is responsible for graphics interface software development and maintenance, application software modification when compatibility problems are encountered, and assisting application programmers where a graphics interface is desirable. Currently the majority of application software packages maintained by TRAC and requiring graphics capabilities utilize a package known as the Kellner Graphics Interface Package (KGIP) named for its author Mr. Al Kellner, TRAC-WSMR. This document discusses three major projects undertaken by TAB-GT to meet the previously mentioned responsibilities which led to the modification of the KGIP and eventual evolution of an even more sophisticated graphics interface package compatible with any TRAC VAX/Ramtek hardware configuration. GRA

N88-12292# Cornell Univ., Ithaca, N.Y. Mathematical Sciences Inst.
ANNOTATED COMPUTER OUTPUT FOR ILLUSTRATIVE EXAMPLES OF CLUSTERING USING THE MIXTURE METHOD AND TWO COMPARABLE METHODS FROM SAS Interim Technical Report
K. E. Basford, N. J. Miles-Dermott, and W. T. Federer 26 Jun. 1987 47 p
(Contract DAAG29-85-C-0018)
(AD-A184687; ARO-23306.91-MA) Avail: NTIS HC A03/MF A01 CSCL 09B

This is the annotated computer output for the three clustering methods considered in the associated technical report, Illustrative Examples of Clustering using the Mixture Method and Two Comparable methods from SAS, by Basford, Federer generated from a fortran program, KMM, written by Basford. Two other clustering methods are considered and are from SAS/CLUSTER, Version 5. These are Ward's method and the EML method. Two real data sets are processed. GRA

N88-12293# Rome Air Development Center, Griffiss AFB, N.Y.
ERIC: AN OBJECT-ORIENTED SIMULATION LANGUAGE
Michael L. Hilton Jun. 1987 57 p
(AD-A184757; RADC-TR-87-103) Avail: NTIS HC A04/MF A01 CSCL 09B

ERIC is an object-oriented programming language designed for supporting the development of intelligent, discrete, event-driven simulations. ERIC was developed as part of an on-going research effort at the Rome Air Development Center to build a new generation of knowledge-based simulations that support Battle Management studies. Object-oriented programming languages are designed to support the development and maintenance of large, complex software systems. These systems are composed of objects which have certain attributes and behaviors. Objects communicate with each other by message passing. The object-oriented paradigm is particularly useful for modelling and simulation because many real-world systems are composed of objects whose interactions can be represented by messages. This

report is a description of the ERIC programming language. It does not assume the reader is familiar with object-oriented programming or simulation; however, it does assume that the reader is familiar with Lisp. GRA

N88-12294# Illinois Univ., Urbana. Coordinated Science Lab.
TOKEN EXECUTION STRATEGIES FOR DISTRIBUTED ALGORITHMS: SIMULATION STUDIES M.S. Thesis
Mark J. Lloyd Jul. 1987 49 p
(Contract N00014-85-K-0570)
(AD-A184792; UILU-ENG-87-2245; ACT-81) Avail: NTIS HC A03/MF A01 CSCL 09B

Six variations of the token execution strategy of a distributed algorithm are described, applied to an algorithm for computing the minimum-weight spanning tree simulated on three network topologies, and compared with the chaotic execution strategy. In a chaotic execution, a processor may transmit a message M as soon as it generates M. In a token execution, a processor may transmit a message only when it holds a unique token. The token execution limits the number of messages in transit at the time. Execution with one token allows the user to observe the response to each message sequentially; execution with a fixed number of tokens provides a congestion control strategy. The best combination of variations of the token execution strategy uses 5.6% to 15.8% more messages and 0% to 12.3% more execution time than the chaotic execution, depending on network topology. GRA

N88-12295# American Society for Engineering Education, Washington, D. C.
THE CIRCULAR SERIAL AUTOCORRELATION COMPUTER PROGRAM
S. Giles Apr. 1987 37 p
(Contract N00014-83-D-0689)
(AD-A184795) Avail: NTIS HC A03/MF A01 CSCL 09B

This report contains guidelines for using the circular serial autocorrelation filter (CSAF) program. The CSAF program is a later version of an algorithm called SFILTR. In the first section basic instructions to the user are discussed. The requirements of the program are also presented in the first section. Interpretation of the program's outputs is given in the second section. In the next section, things which the user should not do are presented. The fourth section is a three part discussion. Mathematical theory related to the filter is presented in the first part; then the program's organization in terms of functions of its subroutines and main program is discussed in the second part. Following this part are listings of important program variable definitions and the entire program along with a flowchart and sample run streams in the third part. In essence, this report contains the most detailed description of the circular serial autocorrelation filtering tool to date. GRA

N88-12296# Rochester Univ., N. Y. Dept. of Statistics.
ALGORITHMS AND HARDWARE FOR EFFICIENT IMAGE SMOOTHING
Anup Basu and Christopher M. Brown Dec. 1984 22 p
(TR-149) Avail: NTIS HC A03/MF A01

Algorithms for efficient implementation of mean and separable median filters for image noise smoothing are developed. The procedures use one-dimensional algorithms repeatedly to obtain two-dimensional mean and separable median in less than or = 4 and 4(log2(n+1))-2 operations, respectively, for an n x n square neighborhood (nbhd). A simple generalization of the algorithms to k dimensions shows that at most 2k and k(2(log2(n+1))-1) operations are required for obtaining the mean and separable median of an n(k) nbhd. However, parallel processing can be easily applied to these algorithms. Given only five parallel processors, less than one operation is required to obtain the sum of an n x n nbhd in two dimensions, and for n less than or = 31 the maximum number of comparisons required to obtain the two-dimensional separable median filter of an n x n nbhd is reduced to less than four. It is demonstrated experimentally that the separable median filter performs better than a median filter for certain classes of images. A simple hardware implementation of the algorithm is also outlined. It is shown that the complexity of this implementation increases linearly depending on the number of inputs, unlike sort-based implementations whose complexity increases exponentially. M.G.

N88-12297*# Sterling Software, Palo Alto, Calif.
THE NETWORK QUEUEING SYSTEM
Brent K. Kingsbury Dec. 1986 63 p
(Contract NAS2-11786)
(NASA-CR-177433; NAS 1.26:177433) Avail: NTIS HC A04/MF A01 CSCL 09B

Described is the implementation of a networked, UNIX based queueing system developed on contract for NASA. The system discussed supports both batch and device requests, and provides the facilities of remote queueing, request routing, remote status, queue access controls, batch request resource quota limits, and remote output return. Author

N88-12298# Rochester Univ., N. Y. Lab. for Laser Energetics.
ISSUES IN IMAGE PROCESSING SOFTWARE DEVELOPMENT FOR A MULTI-USER, MULTI-PROGRAMMING ENVIRONMENT
N. Sampat and S. Swales 1987 7 p Presented at the SPIE Cambridge Symposium on Intelligent Robots and Computer Vision, Cambridge, Mass., 1 Nov. 1987
(Contract DE-FC08-85DP-40200)
(DE88-000358; DOE/DP-40200/52; CONF-871163-3) Avail: NTIS HC A02/MF A01

The general characteristics of a practical image processing system are presented from a software engineering perspective. The system described is targeted for a multi-user, multi-tasking environment in an organization with continuously changing needs. Issues in designing the fundamental software required to achieve such an application-oriented image processing system are discussed. Interactive tools and source code prototypes for enhancing the software and developing extensions to the system are explained. At all stages in the design of this system, software engineering principles such as program portability, readability and maintenance are emphasized. Such an approach in the design of an Image Processing Software System effectively increases programmer productivity and yields a system with high program reliability and dependable long-term maintenance. DOE

N88-12299# Naval Postgraduate School, Monterey, Calif.
ADAMEASURE: AN IMPLEMENTATION OF THE HALSTEAD AND HENRY METRICS M.S. Thesis
Paul M. Herzig Jun. 1987 185 p
(AD-A184005) Avail: NTIS HC A09/MF A01 CSCL 09B

A software metric is a tool that should be used in the development of quality software. The properties that define good software vary but encompass reliability, complexity, efficiency, testability, understand-ability, and modifiability. The Henry metric measures the complexity of data flow within a module and the complexity of intermodule communication. This thesis is an extension of a previous thesis titled AdaMeasure that calculated the Halstead metric. The present design and implementation is a tool that computes the Halstead and Henry metrics of Ada programs. GRA

N88-12300# Naval Postgraduate School, Monterey, Calif.
COMPARISON OF PASCAL AND THE dBASE 3 PLUS LANGUAGE IN PROGRAMMING AN INVENTORY MANAGEMENT SYSTEM M.S. Thesis
To Chang Jun. 1987 203 p
(AD-A184027) Avail: NTIS HC A10/MF A01 CSCL 09B

Before the widespread use of Database Management Systems (DBMS), programmers have had to rely on the third generation language such as COBOL, Pascal, and PL/I to implement their application programs. These programs are usually very hard to maintain and modify unless very disciplined structured programming techniques are used. However, with the DBMS, the ease of development, maintenance, and modification of data-managing application programs can be attained. In this thesis, we compare

two versions of an inventory management program, one written in Apple Pascal and the other written in dBASE III PLUS, in terms of their modifiability and maintainability. GRA

N88-12301# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
END OF YEAR REPORT FOR PARALLEL VISION ALGORITHM DESIGN AND IMPLEMENTATION Technical Report, 15 Jan. 1986 - 14 Jan. 1987
Takeo Kanade and Jon A. Webb Jun. 1987 32 p
(Contract DACA76-85-C-0002)
(AD-A184327; CMU-RI-TR-87-15) Avail: NTIS HC A03/MF A01 CSCL 09B

The parallel vision algorithm design and implementation project was established to facilitate vision programming on parallel architectures, particularly low-level vision and robot vehicle control algorithms on the Carnegie Mellon Warp machine. To this end, we have (1) demonstrated the use of the Warp machine in several different algorithms; (2) developed a specialized programming language, called Apply, for low-level vision programming on parallel architectures in general, and Warp in particular; (3) use Warp as a research tool in vision, as opposed to using it only for research in parallel vision; and (4) developed a significant library of low-level vision programs for use on Warp. GRA

N88-12302# Aerospace Corp., El Segundo, Calif. Lab. Operations.
SDVS (STATE DELTA VERIFICATION SYSTEM): PROGRAM VERIFICATION SYSTEM DEVELOPMENT FISCAL YEAR 1986 Final Report
Leo G. Marcus 1 Jul. 1987 14 p
(Contract F04701-85-C-0086)
(AD-A184338; TR-0086(6778)-1; SD-TR-87-35) Avail: NTIS HC A02/MF A01 CSCL 09B

Progress made in the State Delta Verification System (SDVS) research and development effort for fiscal year 1986 is described. The long-term goal of the field of program verification is to be able to prove the correctness of any program with respect to its (correct) specification. Existing program verification systems can be classified according to their intended domain of application, degree of user interaction, and choice of specification language. SDVS 5 is the current version of a program verification project that essentially started in Crocker's thesis and has progressed since then in capability of proof, ease of user interface, and complexity of applications actually tackled. SDVS is a highly interactive proof checker for proofs of microcode correctness. SDVS 5 runs on the Symbolics Lisp Machine version 6. It consists of three modules: the kernel and user interface (6000 lines of lisp code), the simplifier (14,000 lines of lisp code), and the translator from the ISPS machine description language to state deltas (4000 lines of lisp code). The kernel directs the symbolic execution and checks the validity of the dynamic proof commands. The simplifier encodes the system's knowledge of static domains and allows the user to create and prove lemmas for future use. The translator converts descriptions written in an expanded ISPS to the internal state delta language. GRA

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-12303# Brown Univ., Providence, R. I.
THE MICROVAX-BASED DATA ACQUISITION SYSTEM FOR D0
David Cutts, Jan S. Hoftun, James McLean, Christopher R. Johnson, and Raymond T. Zeller (Zeller Research Ltd., Cranston, R.I.) 1987 10 p Presented at the 5th Conference on Real-Time Computer Applications in Nuclear, Particle, and Plasma Physics, San Francisco, Calif., 12-14 May 1987
(Contract DE-AC02-76ER-03130)
(DE87-014475; DOE/ER-03130/36; CONF-870552-25) Avail: NTIS HC A02/MF A01

A large array of MicroVAX computers will be used for high-speed data acquisition and online filtering in the D0 experiment at Fermi National Laboratory. Described is this system, as well as several smaller data acquisition systems now operational, with particular emphasis on the control and communication software. The computers in this array will run under VAXELN. DOE

N88-12304# Lawrence Livermore National Lab., Calif.
LAYERING CENTRAL AUTHENTICATION ON THE INTERACTIVE SERVICES OF AN EXISTING HOMOGENEOUS DISTRIBUTED SYSTEM
D. M. Nessett Feb. 1987 21 p Presented at the Symposium on Operating Systems Principles, Austin, Tex., 9 Nov. 1987
(Contract W-7405-eng-48)
(DE87-011544; UCRL-96080; CONF-871141-1) Avail: NTIS HC A03/MF A01

Provision of interactive terminal service in a distributed system requires mechanisms to establish and disestablish a terminal session (i.e., to logon and logoff) as well as to move textual data between the terminal host and remote host. Logon occurs in most distributed systems subsequent to the establishment of a terminal session by means of host specific logon procedures. However, in a distributed system of any size, this approach leads to security and password management problems. When the distributed system is homogeneous, these problems can be rectified through the use of a central authentication service that presents a common logon interface to the user for all distributed system hosts. Normally, central authentication is provided by either initially designing it into a distributed system or supporting it through the modification of existing distributed system and host operating system software. As an alternative strategy, central authentication can be layered onto the existing interactive terminal services of a distributed system. An experiment to assess the feasibility of this approach was carried out. The results demonstrate that layering can be used in certain circumstances to provide central authentication services. The experiment also determined what terminal service features are necessary so that central authentication is easily added to a distributed system. Recommendations are made concerning how to structure terminal services in a distributed system so that central authentication is effectively achieved. DOE

N88-12305# Technische Hogeschool, Delft (Netherlands). Onderafdeling der Wiskunde en Informatica.
DELFT PARALLEL PROCESSOR 84/16
J. H. M. Andriessen 1986 28 p Presented at the 2nd SIAM Conference on Parallel Processing for Scientific Computing, Norfolk, Va., 19 Nov. 1985
(PB87-226254; Rept-86-26) Copyright Avail: NTIS HC A03/MF A01 CSCL 09B

The development of the Delft Parallel Processor started in 1976. Since then the machine has grown to a processor with 16 independently operating, but tightly connected processing elements. The parallel processor is supervised by a host processor. The philosophy of the architecture is outlined. The philosophy is based on the experience with parallel simulation of systems. The main requirements are: parallel processing elements, independent and autonomous execution of the parallel subprograms, and full interconnection between the processing elements. Then, the interconnection between the processing elements, the architecture of the processing elements, and the configuration of the host processor are discussed. This includes the description of their functional tasks. GRA

N88-12306# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTERFACING DISTRIBUTED OPERATING SYSTEMS Final Report, Oct. 1985 - Oct. 1986
A. Echenique Jul. 1987 26 p
(Contract N66001-86-D-0084)
(AD-A184489; BBN-6375; NOSC-TD-1120) Avail: NTIS HC A03/MF A01 CSCL 09B

BBN has developed a operating system. Cronus functions in the context of a heterogeneous internetwork system architecture. Cronus is intended to introduce coherence and uniformity to a set of otherwise independent and disjoint computer systems. Cronus also provides a development methodology, tools and mechanisms to support distributed application development and support for functional properties such as scalability, resource management, and survivability. GRA

N88-12307# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
CONCEPTS AND TECHNIQUES FOR SUPPORT OF REAL TIME DISTRIBUTED OPERATING SYSTEMS Interim Report, Feb. - Dec. 1985
Jul. 1987 264 p
(Contract N66001-83-C-0305)
(AD-A184491; NOSC-TD-1113) Avail: NTIS HC A12/MF A01 CSCL 09B

Contained in this report are three major design specifications for the ArchOS decentralized operating system that is being built at CMU as part of the Archons project with partial support from NOSC. Each design specification appears as a separate chapter in Section II of this report. The Client Interface Specification in Chapter 4 describes the functionality of ArchOS as seen by client application programs. In Chapter 5, the ArchOS System Architecture Specification summarizes the structure of ArchOS that supports the ArchOS client interface. Chapter 6 contains the System Design Description of ArchOS. The System Design describes the structure and functionality of major components of ArchOS, such as the ArchOS kernel, the arobject/process management subsystem, the transaction subsystem, the file subsystem, the I/O device subsystem, the time-driven scheduler subsystem, and the monitoring and debugging subsystems. GRA

N88-12308# Integrated Systems Analysts, Inc., Chula Vista, Calif.
UNIX BENCHMARK SYSTEM Final Report, Aug. 1985 - May 1986
T. Brewer Jul. 1987 61 p
(Contract N66001-84-D-0063)
(AD-A184492; NOSC-TD-1111) Avail: NTIS HC A04/MF A01 CSCL 09B

In March 1986, NAVOCEANSYSCEN tasked ISA to prepare a comprehensive test suite to systematically test and evaluate a variety of computer systems and compare the results. NAVOCEANSYSCEN supplied ISA with their Pre-Award test suite, with instructions to also include certain published tests, such as the Dhrystone and Whetstone benchmarks. It was ISA's task to consolidate all the designated tests into one easily-runnable program which can be used by either Government or Contractor personnel to test all computer systems that are candidates for procurement. NAVOCEANSYSCEN selected the VAX 11/780 under UNIX 4.3 BSD as the baseline system to which each target system (procurement candidates) would be compared. Our program, bench, collects and stores test results from the baseline system, collects and stores results from all the target systems, and producess two reports. The first report compares any two systems which the user selects, and the second report summarizes all the test data in one report. The user tells the program which of these tasks he wishes performed through the use of options on the input line. All input is in standard UNIX format. GRA

N88-12309# SRI International Corp., Menlo Park, Calif.
NETWORK RECONSTITUTION PROTOCOL Final Report, Sep. 1983 - May 1986
Ames E. Mathis, Barbara Denny, Robert Gilligan, Dwight Hare, and Rodney Reining Jun. 1987 97 p
(Contract F30602-83-C-0027)
(AD-A184755; SRI-5453; RADC-TR-87-38) Avail: NTIS HC A05/MF A01 CSCL 09B

The potential of achieving resource-sharing by interconnecting various types of packet-switched networks led to the development of internetworking. The current proliferation of packet-switching networks, local area networks, and gateways has resulted in a large internetwork system with rich connectivity and hence potential survivability in the face of node and link failures. Unfortunately, the current DOD internetwork architecture and protocols were developed with a static environment in mind; that is, one in which hosts do not quickly relocate and networks do not quickly merge or partition. The current internetwork is concerned with topology changes brought about primarily by failures in gateways rather than substantial changes in network structure or organization; thus the potential for survivability of the internetwork system is largely unrealized. When packet switching and internetwork technologies are applied to the real-world problems of the military services, deficiencies often become apparent. In the Strategic C3 Experiment packet-radio technology 4 offers flexibility of operation and support for mobile nodes (aircraft); However, this flexibility and mobility is not adequately supported at the internetwork level. Early in the experiments three primary deficiencies were uncovered that relate to: (1) Partitioning of network; (2) Merging of networks; and (3) Maintaining communications to network-mobile hosts. GRA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-12310# Technische Univ., Berlin (West Germany). Inst. fuer Angewandte Informatik.
THE USER'S GUIDE TO THE BACK SYSTEM
Christof Peltason, Kai vonLuck, Bernhard Nebel, and Albrecht Schmiedel Jan. 1987 61 p Sponsored by the European Economic Commission, and the ESPRIT Project 311
(KIT-42; ISSN-0931-0436; ETN-87-91060) Avail: NTIS HC A04/MF A01

The knowledge representation system BACK which provides a well defined functionality as part of a larger, knowledge based system is outlined. The basic ideas rely on the paradigm which emerged from work on KL-ONE and related representation systems. A strict distinction between how the terminological and the assertional knowledge is dealt with characterizes BACK as a hybrid representation system. ESA

N88-12311# Brown Univ., Providence, R. I. Center for Neural Science.
GENERAL POTENTIAL SURFACES AND NEURAL NETWORKS
Amir Dembo and Ofer Zeitouni 24 Jun. 1987 32 p
(Contracts DAAG29-84-K-0202; N00014-86-K-0041)
(AD-A184484; TR-42; ARO-22000.8-LS) Avail: NTIS HC A03/MF A01 CSCL 09B

Investigating Hopfield's model of associative memory implementation by a neural network, led to a generalized potential system with a much superior performance as an associative memory. In particular, there are no spurious memories, and any set of desired points can be stored, with unlimited capacity (in the continuous time and real space version of the model). There are no limit cycles in this system, and the size of all basins of attraction can reach up to half the distance between the stored points, by proper choice of the design parameters. A discrete time version with its state space being the unit hypercube is also derived, and admits superior properties compared to the corresponding Hopfield network. In particular the capacity of any system of N neurons, with a fixed desired size of basins of attractions, is exponentially growing with N and is asymptotically optimal in the information theory sense. The computational complexity of this model is slightly larger than that of the Hopfield memory, but of the same order. The results are derived under an axiomatic approach which determines the desired properties and shows that the above mentioned model is the only one to achieve them. GRA

N88-12312# Unisys Corp., San Diego, Calif. San Diego Systems Engineering Center.
A SURVEY OF ARTIFICIAL NEURAL SYSTEMS Final Report
Patrick K. Simpson Jun. 1987 42 p Sponsored by Naval Ocean Systems Center, San Diego, Calif.
(AD-A184759; NOSC-TD-1106) Avail: NTIS HC A03/MF A01 CSCL 09B

The field of artificial neural systems (ANS) was surveyed. Artificail Neural Systems have a large number of highly interconnected processing elements that demonstrate the ability to learn and generalize from presented patterns. The ANSs represent a possible solution to previously difficult problems in areas such as speech processing and natural language understanding. Included are a history of ANS, examples of ANS models, and areas there the technology was applied. Also discussed in the connection between Artificial Intelligence (AI) and ANS, computer architecture that are evolving from this field, and ANS algorithms. Author

N88-12313# University of Southern California, Marina del Rey. Information Sciences Inst.
ANTITHESIS: A STUDY IN CLAUSE COMBINING AND DISCOURSE STRUCTURE
William C. Mann and Sandra A. Thompson Apr. 1987 33 p
(Grant NSF IST-84-08726)
(AD-A184789; ISI/RS-87-171) Avail: NTIS HC A03/MF A01 CSCL 09B

Artificial Intelligence (AI) Research in text generation needs a strong linguistically justified descriptive theory as a basis for creating methods by which programs can write multiparagraph texts. This paper sketches Rhetorical Structure Theory, which has been designed to support text generation, and then applies RST to describing a particular class of discourse constructs. There is no concensus as to the status of clause combining relations relative to larger texts. This paper demonstrates a clause combining relation that is also found as part of larger text structures, and shows how this fact can be used to explain cases in which contrastive clause combining appears between clauses that are not in fact in contrast. The appropriate generalization is that the relations of clause combining and the relations of general text structure are the same. Use of this generalization should make AI text planning and text generation significantly easier. GRA

N88-12314# Pittsburgh Univ., Pa. Learning Research and Development Center.
AN OBJECT-ORIENTED ARCHITECTURE FOR INTELLIGENT TUTORING SYSTEMS
Jeffrey Bonar, Robert Cunningham, and Jamie Schultz 14 Aug. 1987 17 p
(Contracts N00014-83-C-0148; N00014-83-K-0655; F41689-84-D-0002; Proj. RR0-4206)
(AD-A184790; UPITT/LRDC/ONR/LSP-3) Avail: NTIS HC A03/MF A01 CSCL 09B

This report describes an object oriented architecture for intelligent tutoring systems, oriented around objects that represent the knowledge elements to be taught by the tutor. Each of these knowledge elements, called bites inherits both a knowledge organization describing the kind of knowledge represented and tutoring components that provide the functionality to accomplish standard tutoring tasks like diagnosis, student modeling, and task selection. We illustrate the approach with several tutors implemented at the Learning Research and Development Center. GRA

N88-12315# Illinois Univ., Urbana. Dept. of Computer Science.
THE STRUCTURE-MAPPING ENGINE: ALGORITHM AND EXAMPLES
Brian Falkenhainer, Kenneth D. Forbus, and Dedre Gentner Jul. 1987 68 p
(Contract N00014-85-K-0559; RRO-4206)
(AD-A184042; UIUCDCS-R-87-1361) Avail: NTIS HC A04/MF A01 CSCL 09B

This paper describes the Structure-Mapping Engine (SME), a program for studying analogical processing. SME is based on Gentner's Structure-Mapping theory of analogy, and provides a tool kit for constructing matching algorithms consistent with this theory. Its flexibility enhances cognitive simulation studies by simplifying experimentation. Furthermore, SME is very efficient, making it a useful component in machine learning systems as well. We review the Structure-Mapping theory and describe the design of the engine. We analyze the complexity of the algorithm, and demonstrate that most of the steps are polynomial, typically bounded by theta (N sq.) We demonstrate some examples of its operation taken from our cognitive simulation studies and work in machine learning, and then we compare SME to other analogy programs GRA

N88-12316# Advanced Decision Systems, Mountain View, Calif.
PERFORMANCE EVALUATION OF ARTIFICIAL INTELLIGENCE SYSTEMS Final Report, 26 Sep. 1986 - 30 Jun. 1987
Richard M. Tong, Neville D. Newman, Gary Berg-Cross, and Fred Rook 17 Aug. 1987 124 p
(Contract DAAH01-86-C-1053; ARPA Order 5916)
(AD-A184054; ADS-TR-3154-01) Avail: NTIS HC A06/MF A01 CSCL 09B

The major premise is that the DoD is moving towards the large-scale use of Artificial Intelligence Systems (AISs) as tools for supporting decision making and information analysis in military domains. It becomes increasingly important, therefore, that we develop mechanisms both for assessing the impact that these systems have upon the ability of the individual decision makers and analysts to carry out their assignments, and for assessing the organizational impact that this would have. This is what we choose to call the problem of Performance Evaluation. This report describes the development of a methodology for performance evaluation. This approach provides for both multiple perspectives on the problem and multiple evaluation techniques. The central idea in our methodology is that of an evaluation frame. This is the main organizational element in this representation of performance knowledge. To validate the methodology, a number of example evaluations are performed of expert systems building tools and decision aids, also using the results to help us define a prototype evaluation environment. The evaluations and the design are reported in full. This proposed methodology has a high likelihood of success. GRA

N88-12317# Naval Postgraduate School, Monterey, Calif.
MICROCOMPUTER CONTROL OF A HYDRAULICALLY ACTUATED PISTON M.S. Thesis
Ian Grunther Jun. 1987 54 p
(AD-A184130) Avail: NTIS HC A04/MF A01 CSCL 13G

This thesis is a study of a computer controlled hydraulically actuated piston. The system uses a Hewlett Packard HP85B microcomputer as a controller. Included in this research is a detailed computer simulation of the system with laboratory validation. This effort supports the overall goal of complete study of microcomputer control of electrohydraulic power systems by the establishment and simulation modeling of a baseline system. Special emphasis is placed on modeling the effects of the computer on important factors influencing the ability to control a hydraulic power element using a microcomputer. Proper selection of the sampling period alone is not always sufficient to insure the ability to control the plant. Other factors such as non-linearities in the plant may influence the ability to use a digital controller. GRA

N88-12318# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
RECOGNIZING RIGID OBJECTS BY ALIGNING THEM WITH AN IMAGE
Daniel P. Huttenlocher and Shimon Ullman Jan. 1987 45 p
(Contract N00014-85-K-0124)
(AD-A184253; AI-M-937) Avail: NTIS HC A03/MF A01 CSCL 09B

This paper presents an approach to recognition where an object is first aligned with an image using a small number of pairs

of model and image features, and then the aligned model is compared directly against the image. For instance, the position, orientation, and scale of an object in three-dimensional space can be determined from three pairs of corresponding model and image points. By using a small fixed number of features to determine position and orientation, the alignment method avoids structuring the recognition process as an exponential search. To demonstrate the method, presented are some examples of recognizing flat rigid objects with arbitrary three-dimensional position, orientation, and scale, from a single two-dimensional image. The recognition system chooses features for alignment using a scale-space segmentation of edge contours. Segments are described in terms of both their shape and the structure of the scale-space hierarchy at the next finer level, producing distinctive features for use in finding possible alignments. Finally, the method is extended to the domain of non-flat objects as well. GRA

N88-12319# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
LISP AS A RAPID PROTOTYPING ENVIRONMENT: THE CHINESE TUTOR
Dario Giuse Jun. 1987 20 p
(Contract F33615-84-K-1520; ARPA Order 4976)
(AD-A184328; CMU-RI-TR-87-14) Avail: NTIS HC A02/MF A01 CSCL 09B

Conventional wisdom has maintained that while LISP is suitable for the development of experimental software, it does not support production-quality systems well. This report describes a building-block approach where a complex system (an intelligent Chinese language tutor) was built in a LISP environment out of a series of powerful tools. The resulting system does not in any way sacrifice performance for power and flexibility. Author (GRA)

N88-12320# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
LOW-LEVEL VISION ON WARP AND THE APPLY PROGRAMMING MODEL
Leonard G. Harney, Jon A. Webb, and Wu, I-Chen Jul. 1987 22 p
(Contracts F33615-81-K-1539; N00039-85-C-0134; DACA76-85-C-0002; N00014-80-C-0236; N00014-85-K-0152)
(AD-A184330; CMU-RI-TR-87-17) Avail: NTIS HC A02/MF A01 CSCL 09B

In the course of implementing low-level (image to image) vision algorithms on Warp, we have understood the mapping of this class of algorithms well enough so that their programming is now a straightforward and stereotypical task. The partitioning method used is input partitioning, which provides an efficient, natural implementation of this class of algorithms. We have developed a special programming language called Apply, which reduces the problem of writing the algorithm for this class of programs to the task of writing the function to be applied to a window around a single pixel. Apply provides a method for programming Warp in these applications which is easy, consistent, and efficient. Apply is application specific, but machine independent-it is possible to implement versions of Apply which run efficiently on a wide variety of computers. We describe implementations of Apply on Warp, UNIX and the Hughes HBA, and sketch implementation on bit-serial processor arrays and distributed memory machines. GRA

N88-12321# Illinois Univ., Urbana. Dept. of Computer Science.
ANALOGICAL INFERENCE AND ANALOGICAL ACCESS
Dedre Gentner 4 Aug. 1987 56 p
(Contract N00014-85-K-0559; RR0-4206)
(AD-A184345; UIUCDCS-R-87-1365; UILU-ENG-87-1753) Avail: NTIS HC A04/MF A01 CSCL 05F

Analogy is a powerful technique in commonsense learning and reasoning. People use analogies in problem solving, in developing mental models of a new domain, and in communicating knowledge. To model these natural uses of analogy, we need to understand the whole process of analogizing from the first, starting with access and ending with drawing inferences or extracting a principle from an analogy. The structure-mapping theory of analogical processing is first reviewed and a simulation of the theory described. This framework is then extended to accessing analogy. Recent research is discussed suggesting that the accessibility of an analogical match is governed by different factors from its inferential soundness. Finally, competing theoretical approaches to analogy are considered and an integrated architecture for analogical processing suggested. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-12322# Texas Univ., Austin.
PERTURBATION AND CHARACTERIZATION OF NONLINEAR PROCESSES Progress Report, 15 Nov. 1983 - 1 Jun. 1987
H. L. Swinney and J. Swift 1987 8 p
(Contract DE-AS05-84ER-13147)
(DE87-014580; DOE/ER-13147/3) Avail: NTIS HC A02/MF A01

This progress report summarizes the principal accomplishments dealing with perturbation and characterization of nonlinear processes. Topics of research include Lyapunov equations, mutual information and metric entropy, the dimensions, complex dynamics and transition sequences and spatial patterns. DOE

N88-12323*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MONTE CARLO SIMULATION OF MODULATED PHASES
D. J. Srolovitz, G. N. Hassold, and J. Gayda 1987 11 p Presented at the Dynamics of Ordering Processes in Condensed Matter, Kyoto, Japan, 27 Aug. 1987 Prepared in cooperation with Los Alamos National Lab., N. Mex. and Michigan Univ., Ann Arbor
(Contract W-7405-eng-36)
(NASA-TM-89654; NAS 1.15:89654; DE87-014729; LA-UR-87-2702; CONF-8708122-1) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper presents Monte Carlo simulation results for the formation of modulated phases in the framework of the two dimensional ANNNI model with a nonconserved order parameter. This work complements the earlier studies of Kaski, et al. by examining a different, wider area of parameter space and temperature. Like Kaski, et al., it is found that for certain temperatures and values of the frustration parameter, kappa, ordered domains form quickly and the correlation length grows as the square root of time. However, there exists a range of kappa for which a quench from high to low temperature results in the formation of a metastable glassy phase. In addition to the ANNNI model study, preliminary results are presented on a newly developed model which exhibits phase modulation due to the presence of elastic interactions between the different phase and with an externally applied stress. DOE

N88-12324# Lawrence Livermore National Lab., Calif.
NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS ON IRREGULAR GRIDS
C. David Levermore, Thomas A. Manteuffel, and Andrew B. White, Jr. (Los Alamos National Lab., N. Mex.) 1987 10 p Presented at the International Symposium on Computational Fluid Dynamics and International Conference on Computational Techniques and Applications, Sydney, Australia, 24-27 Aug. 1987
(Contract W-7405-eng-36)
(DE87-014760; LA-UR-87-2842; CONF-8708128-1) Avail: NTIS HC A02/MF A01

The order of error in numerical solutions of differential equations is discussed. In particular, the effect of size and shape of the grid imposed on the problem is examined. The author concludes that the rate of convergence is the same on an irregular grid as it is on a regular grid in many instances. DOE

N88-12325# Illinois Univ., Urbana.
THE DEVELOPMENT OF ODE METHODS: A SYMBIOSIS BETWEEN HARDWARE AND NUMERICAL ANALYSIS
1986 17 p
(Contract DE-FG02-87ER-25026)
(DE87-014925; DOE/ER-25026/T1) Avail: NTIS HC A03/MF A01

The history of the numerical solution of ordinary differential equations is surveyed from its origins three centuries ago up to the early 1970s. The increasing demands for the solution of ODEs, especially for exterior ballistics and celestial mechanics, have been a primary stimulus of and a significant influence on the early development of computers starting with the analog differential analyzers and continuing to the first wired-program digital computers - whose form foreshadowed future developments in parallel computers. At the same time the hardware has, of course, affected the algorithms used, but this has resulted in surprisingly few innovations in numerical techniques. DOE

N88-12326# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ASYMPTOTICS OF THE EFFECTIVE POTENTIALS AND WAVE FUNCTIONS OF A THREE-BODY PROBLEM IN SUITABLE COORDINATES
S. I. Vinitskij and M. B. Kadomtsev 1986 10 p In RUSSIAN
(DE87-703323; JINR-R-4-86-244) Avail: NTIS (US Sales Only) HC A02/MF A01

An equivalent operator removing degeneration in a layer with the principal quantum number n is recognized for the two-center Coulomb problem in suitable coordinates at large distances between the centers. Averaging of the total Hamiltonian over the correct zero-order adiabatic functions allows one to record the asymptotic system of equations. The solution of this system of equations is found to be compatible with the physical boundary conditions of the scattering problem. DOE

N88-12327# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain). Dept. de Aerodynamica y Navegabilidad.
APPLICATION OF THE FINITE DIFFERENCE METHOD TO THE SOLUTION OF MIXED PARTIAL DIFFERENTIAL EQUATIONS FOR THE CASE OF TRANSONIC FLOW [APLICACION DEL METODO DE DIFERENCIAS FINITAS A LA RESOLUCION DE ECUACIONES DIFERENCIALES EN DERIVADAS PARCIALES MIXTAS PARA EL CASO DE FLUJO TRANSONICO]
Fernando MongeGomez 1987 15 p In SPANISH; ENGLISH summary
(ETN-87-90760) Avail: NTIS HC A03/MF A01

A procedure for solving partial differential equations is presented. It is based upon the use of a rotated difference scheme along with an additional retarding term. Applications to the analysis of airfoils in transonic flow are shown, as well as a comparison with experimental results. The examples show good agreement with experimental data, confirming the validity of the model. The technique is easily adaptable to the three dimensional case. ESA

N88-12328# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
THEORETICAL AND PRACTICAL ASPECTS OF MULTIGRID METHODS IN BOUNDARY ELEMENT CALCULATIONS
H. Schippers 22 Feb. 1985 39 p Submitted for publication
(NLR-MP-85021-U; ETN-87-91324) Avail: NTIS HC A03/MF A01

Multigrid methods are advocated for the fast solution of the large nonsparse systems of equations that occur in boundary element methods. It is shown that the decomposition should take the edges of the boundary into account, because they have a strong influence on the smoothing property of the relaxation scheme. The choice of the coarse-grid operators, the interactions between the grids and the implementation of the algorithm are discussed. Theoretical investigations show that the multigrid method converges more rapidly as the number of boundary elements increases. This is illustrated for two plane problems: potential flow around an airfoil and interior fundamental problem of elasticity. ESA

N88-12329# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material und Festkoerperforschung.
APPLICATION OF VISCOPLASTIC CONSTITUTIVE EQUATIONS IN FINITE ELEMENT PROGRAMS
K. Hornberger (Karlsruhe Univ., West Germany) and H. Stamm
Apr. 1987 61 p In GERMAN; ENGLISH Summary Sponsored by Deutschen Forschungsgemeinschaft, Fed. Republic of Germany
(KfK-4254; ISSN-0303-4003; ETN-87-90588) Avail: NTIS HC A04/MF A01

A viscoplastic constitutive model was described in a commercially available finite element program. The general mathematical formulation of frequently used viscoplastic constitutive equations is explained. The implementation of these equations into finite element programs is described, using Robinson's model as an example. For the numerical integration an explicit (Euler) and an implicit (generalized midpoint rule) integration scheme were used in combination with a time marching strategy. In the implicit integration scheme, the convergence in solving a system of nonlinear algebraic equations is improved by the introduction of a projection method. The efficiency of the implemented procedures is demonstrated for differect homogeneous loadings as well as for creep loading and strain-controlled cyclic loading of a perforated plate. ESA

N88-12330*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INSTITUTE FOR COMPUTATIONAL MECHANICS IN PROPULSION (ICOMP) FIRST YEAR SUMMARY
Nov. 1987 15 p Sponsored in part by the Space Act Agreement No. C99066G
(NASA-TM-100225; ICOMP-87-8; E-3844; NAS 1.15:100225)
Avail: NTIS HC A03/MF A01 CSCL 12A

The Institute for Computational Mechanics in Propulsion (ICOMP) in Cleveland, Ohio, is operated jointly by Case Western Reserve University and the NASA Lewis Research Center. The purpose of ICOMP is to develop techniques to improve problem-solving capabilities in all aspects of computational mechanics related to propulsion. The Institute began operation in 1985. Described are the events leading to its formation, its organization and method of operation, and the technical activities of the first year. Author

N88-12331# Naval Postgraduate School, Monterey, Calif.
IMPLEMENTATION OF THE RUNGE-KUTTA-FEHLBERG METHOD FOR SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS ON A PARALLEL PROCESSOR M.S. Thesis
Colin F. Mayo Jun. 1987 51 p
(AD-A184660) Avail: NTIS HC A04/MF A01 CSCL 12A

A recent advance in computer architecture, the parallel processor computer, has made it theoretically feasible to reduce the time required to integrate a system of n ordinary differential equations by a factor of n. One established numerical technique, the Runge-Kutta-Fehlberg method, is adapted for parallel processing on an Intel Scientific Computer iPSC Concurrent Supercomputer. The algorithm is evaluated using a standardized collection of systems of equations. It is concluded that this type of parallel processor is not suited for the solution of this problem due to the communications overhead required. Short developments of ordinary differential equations and numerical integration methods are provided as background. Author (GRA)

N88-12332*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL EXPERIMENTS WITH A SYMMETRIC HIGH-RESOLUTION SHOCK-CAPTURING SCHEME
H. C. Yee Jun. 1986 10 p
(NASA-TM-88325; Rept-86316; NAS 1.15:88325) Avail: NTIS HC A02/MF A01 CSCL 12A

Characteristic-based explicit and implicit total variation diminishing (TVD) schemes for the two-dimensional compressible Euler equations have recently been developed. This is a generalization of recent work of Roe and Davis to a wider class of symmetric (non-upwind) TVD schemes other than Lax-Wendroff. The Roe and Davis schemes can be viewed as a subset of the class of explicit methods. The main properties of the present class of schemes are that they can be implicit, and, when steady-state calculations are sought, the numerical solution is independent of the time step. In a recent paper, a comparison of a linearized form of the present implicit symmetric TVD scheme with an implicit upwind TVD scheme originally developed by Harten and modified by Yee was given. Results favored the symmetric method. It was found that the latter is just as accurate as the upwind method while requiring less computational effort. Currently, more numerical experiments are being conducted on time-accurate calculations and on the effect of grid topology, numerical boundary condition procedures, and different flow conditions on the behavior of the method for steady-state applications. The purpose here is to report experiences with this type of scheme and give guidelines for its use. Author

N88-12333# Vanderbilt Univ., Nashville, Tenn. Center for Intelligent Systems.

A PROTOTYPE EXPERT SYSTEM FOR SEPARATION SCIENCE

K. A. Debelak, M. R. Leuze, J. R. Bourne, J. E. Whitlow, B. A. Antao, O. Patino-Siliceo, and D. J. Pruett (Oak Ridge National Lab., Tenn.) Aug. 1987 14 p Presented at the American Institute of Chemical Engineers Summer National Meeting, Minneapolis, Minn., 16 Aug.1 987 Prepared in cooperation with Oak Ridge National Lab., TN.

(Contract DE-AC05-84OR-21400)

(DE87-013542; CONF-870822-7) Avail: NTIS HC A02/MF A01

The creation of an expert system that will aid in solving problems in separation science and technology is discussed. Such a system includes a user interface and a core expert system with the ability to access a number of modules designed to retrieve, calculate, and analyze information needed to solve separation problems. These modules include an analytical chemistry data base, existing chemical data bases, regulatory data base, theoretical models, engineering models, and a series of expert systems in each of the important separation technologies. DOE

N88-12334# Argonne National Lab., Ill. Mathematics and Computer Science Div.

NUMERICAL SOLUTION OF BOUND CONSTRAINED PROBLEMS

J. J. More Aug. 1987 13 p

(Contract W-31-109-eng-38)

(DE88-000653; ANL/MCS-TM-96) Avail: NTIS HC A03/MF A01

This paper considers the application of projected gradient techniques to the numerical solution of bound constrained optimization problems. An advantage of algorithms based on projected gradients is that they have the ability to drop and add many constraints at each iteration, and to quickly identify the optimal active constraints. This ability is of importance in large scale problems. In contrast, active set strategies restrict the change in the dimension of the working subspace by only dropping or adding one constraint at each iteration. We introduce and motivate the gradient projection method, and survey some of the recent numerical and theoretical results. In particular, we discuss algorithms that combine trust region methods and projected gradient methods. DOE

N88-12335# Stanford Univ., Calif. Center for Large Scale Scientific Computation.

SOLUTION OF NONLINEAR LEAST-SQUARES PROBLEMS Ph.D. Thesis

Christina Fraley Jul. 1987 270 p

(Contracts N00014-82-K-0335; DAAG29-84-K-0156)

(AD-A184010; CLASSIC-87-04) Avail: NTIS HC A12/MF A01 CSCL 12A

This dissertation addresses the nonlinear least-squares problem where f(x) is a vector whose components are smooth nonlinear functions. The problem arises most often in data fitting applications. Much research has focused on the development of specialized algorithms that attempt to exploit the structure of the nonlinear least-squares objective. It is assumed that n and m are relatively small, so that limited storage and sparsity in the derivatives of f need not be taken into account in formulating algorithms. We first discuss existing numerical algorithms for nonlinear least squares, nearly all of which involve iterative minimization of quadratic function. Methods for general unconstrained optimization, Gauss-Newton methods, Levenberg-Marquardt methods, and special quasi-Newton methods are among the algorithms surveyed. Our emphasis is on those methods that form the basis of widely-distributed software, and numerical results are given for a large set of test problems. The main contribution of this research is to propose new algorithms that make use of more general quadratic programming subproblems. Options are investigated that are based on convergence properties of sequential quadratic programming methods for constrained optimization, and on geometric considerations in nonlinear least squares. Numerical results are given, demonstrating that the new methods may be useful in practice. GRA

N88-12336# Nova Univ., Dania, Fla.

NONLINEAR PARAMETRIC LEAST-SQUARES ADJUSTMENT

George Blaha Mar. 1987 50 p

(Contract F19628-86-K-0006)

(AD-A184039; AFGL-TR-87-0204; SR-1) Avail: NTIS HC A03/MF A01 CSCL 12A

A parametric adjustment model expresses n observables in terms of u parameters, where the structure linking the two groups is in general nonlinear. This model can be expanded in the Taylor series based on an initial point P. The standards procedure includes only the linear terms, constituting a known linearized model at P which is resolved upon applying the least-squares (L.S.) criterion . If necessary, the solution is iterated, i.e., the initial point in a given step is revised using the L.S. result from the previous step. In the present study, the resolution of a nonlinear adjustment model is addressed through an isomorphic geometrical setup with tensor structure and notations, represented by a u-dimensional model surface embedded in an n-dimensional observational space . In this geometrical context, the observations correspond to the observational-s pace coordinates of the point called Q, and the adjusted parameters correspond to the model-surface coordinates of the point called P. The L.S. criterion implies that the vector PQ must be orthogonal to the model surface. GRA

N88-12337# Colorado Univ., Boulder. Dept. of Computer Science.

A COMPUTATIONAL EXAMINATION OF ORTHOGONAL DISTANCE REGRESSION

Paul T. Boggs, Janet R. Donaldson, Robert B. Schnabel, and Clifford H. Spiegelman 8 May 1987 49 p

(Contracts DAAG29-84-K-0140; N00014-86-F-0025)

(AD-A184374; CU-CS-362-87; ARO-21453.10-MA) Avail: NTIS HC A03/MF A01 CSCL 12A

Classical or ordinary least squares (OLS) is one of the most commonly used criteria for fitting data to models and for estimating parameters. This is true when a key assumption for its use, namely that the independent variables are known exactly, is violated. Orthogonal distance regression (ODR) extends least squares data fitting to problems with the independent variables that are not known exactly. Theoretical analysis, however, shows OLS is preferable to ODR for straight line functions under certain conditions, even when there are measurement errors in the independent variable. This has led some to conjecture that under some similar conditions OLS will also be preferable to ODR for nonlinear functions even though there are errors in the independent variable. This paper presents the results of an empirical study designed to examine whether ODR provides better results than

OLS when there are errors in the independent variable. Examined are a variety of functions, both linear and nonlinear, under a variety of experimental conditions. The results indicate that for the data and performance criteria considered, ODR never performs appreciably worse than OLS and sometimes performs considerably better. Author (GRA)

N88-12338# Clarkson Univ., Potsdam, N.Y. Dept. of Mathematics and Computer Science.
GRAPH PARTITIONING BY EIGENVECTORS
David L. Powers 1987 16 p
(Contract N00014-85-K-0497)
(AD-A184430) Avail: NTIS HC A03/MF A01 CSCL 12A

Let A be the adjacency matrix of a connected graph G. If z is a column vector, we say that a vertex of G is positive, nonnegative, null, etc., if the corresponding entry of z has that property. For z such that Az is greater than or = alpha z, we bound the number of components in the subgraph induced by positive vertices. For eigenvectors z having a null element, we bound the number of components in the graph induced by non-null vertices. Finally, bounds are established for the number of null elements in an eigenvector, for the multiplicity of an eigenvalue and for the magnitudes of the second and last eigenvalues of a general or a bipartite graph. GRA

N88-11896# Joint Publications Research Service, Arlington, Va.
COMPACTNESS OF QUASI-CONFORMING ELEMENT SPACES, CONVERGENCE OF QUASI-CONFORMING ELEMENT METHOD
Hongqing Zhang and Ming Wang *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 51-71 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 7, no. 5, May 1986 p 409-423 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-12339*# Wagner (Daniel H.) Associates, Inc., Hampton, Va.
LEAST SQUARES LINEAR LAGS AND LIMITED MEMORY FILTERS
Joseph H. Discenza Oct. 1987 29 p
(NASA Order L-16074-C)
(NASA-CR-178381; NAS 1.26:178381) Avail: NTIS HC A03/MF A01 CSCL 12A

Pure autoregressive (AR) models which are linear in the short term, that is when a variable can be predicted by linear regression on a limited number of past observations, are discussed. When evenly spaced observations are available, a fixed set of AR coefficients can be calculated independent of the data. For filtering purposes, such a lag structure can be implemented recursively with an efficient algorithm. The method of computing variance recursively is also derived. A complete algorithm is presented in the appendix. Author

N88-12340# California Univ., Berkeley. Operations Research Center.
A HETEROSCEDASTIC HIERARCHICAL MODEL
William S. Jewell Apr. 1987 29 p
(Grant AF-AFOSR-0122-81)
(AD-A184256; ORC-87-11) Avail: NTIS HC A03/MF A01 CSCL 12A

Hierarchical models are important in Bayesian prediction because they enable the use of collateral data from related risks with exchangeable parameters. The classical normal-normal-normal model with random means shows clearly how the linear predictive mean for a single risk is improved by the availability of cohort data. However, this model has the disadvantage that the predictive density is homoscedastic, that is, the posterior variance depends only on the design (number of risks and number of samples). In most applications, one would assume that the variance also depended upon the data values. One can, of course, change the variances at each level into random parameters, but this modifies the predictive mean formulae and leads to messy results in general. In the course of examining approximations to predictive variances, the author has found an extended normal model with variances that are quadratic in the data, and with the additional advantage that the linear mean formulae are unchanged. GRA

N88-12341# Educational Testing Service, Princeton, N. J.
EXPLOITING AUXILIARY INFORMATION ABOUT ITEMS IN THE ESTIMATION OF RASCH ITEM DIFFICULTY PARAMETERS
Robert J. Mislevy Jul. 1987 59 p
(Contract N00014-85-K-0683; RR0-4204)
(AD-A184383; ETS-RR-87-26-ONR) Avail: NTIS HC A04/MF A01 CSCL 05H

Standard procedures for estimating the item parameters in IRT models make no use of auxiliary information about test items, such as their format or content, or the skills they require for solution. This paper describes a framework for exploiting this information, thereby enhancing the precision and stability of item parameter estimates and providing diagnostic information about items' operating characteristics. The principles are illustrated in a context for which a relatively simple approximation is available: empirical Bayes estimation of Rasch item difficulty parameters. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-12342*# Research Triangle Inst., Research Triangle Park, N.C.
POTENTIAL APPLICATIONS OF EXPERT SYSTEMS AND OPERATIONS RESEARCH TO SPACE STATION LOGISTICS FUNCTIONS
Thomas F. Lippiatt and Donald Waterman Jun. 1985 73 p
(Contract NAS10-10438)
(NASA-CR-180473; NAS 1.26:180473; N-2315-NASA) Avail: NTIS HC A04/MF A01 CSCL 12B

The applicability of operations research, artificial intelligence, and expert systems to logistics problems for the space station were assessed. Promising application areas were identified for space station logistics. A needs assessment is presented and a specific course of action in each area is suggested. B.G.

N88-12343*# Alabama Univ., Tuscaloosa. Dept. of Mathematics.
STOCHASTIC MODEL OF THE NASA/MSFC GROUND FACILITY FOR LARGE SPACE STRUCTURES WITH UNCERTAIN PARAMETERS: THE MAXIMUM ENTROPY APPROACH
Wei-Shen Hsia 2 Dec. 1987 26 p
(Grant NAG8-081)
(NASA-CR-181489; NAS 1.26:181489) Avail: NTIS HC A03/MF A01 CSCL 12B

A stochastic control model of the NASA/MSFC Ground Facility for Large Space Structures (LSS) control verification through Maximum Entropy (ME) principle adopted in Hyland's method was presented. Using ORACLS, a computer program was implemented for this purpose. Four models were then tested and the results presented. B.G.

N88-12344*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POLYNOMIAL COMPENSATION, INVERSION, AND APPROXIMATION OF DISCRETE TIME LINEAR SYSTEMS
Yoram Baram (Israel Inst. of Tech., Haifa.) Oct. 1987 22 p
(NASA-TM-100027; A-87347; NAS 1.15:100027) Avail: NTIS HC A03/MF A01 CSCL 12B

The least-squares transformation of a discrete-time multivariable linear system into a desired one by convolving the first with a polynomial system yields optimal polynomial solutions to the problems of system compensation, inversion, and approximation. The polynomial coefficients are obtained from the solution to a so-called normal linear matrix equation, whose coefficients are shown to be the weighting patterns of certain linear systems. These, in turn, can be used in the recursive solution of the normal equation. Author

N88-12345# Naval Postgraduate School, Monterey, Calif.
MATHEMATICAL MODELS FOR THE S.D.I. M.S. Thesis
Yoram Ilan-Lipowsky Jun. 1987 154 p
(AD-A184667) Avail: NTIS HC A08/MF A01 CSCL 12B

SDI technologies may affect the concepts of weapons systems and reshape the battlefields of the future. A few of the SDI systems are analyzed and modeled mathematically. The different models are gathered into a software package that may be run on a personal computer. The intention was to produce a handy tool for preliminary studies and designs. The following topics are covered: aerodynamic design of hypervelocity projectiles, flight simulation of hypervelocity projectiles, railgun simulation, ground track of orbits, guidance and homing. A few case studies were analyzed to suggest and demonstrate potential use of these models. Author (GRA)

N88-12346# Army Command and General Staff Coll., Fort Leavenworth, Kansas. School of Advanced Military Studies.
HOW SPACE, THE FOURTH OPERATIONAL MEDIUM, SUPPORTS OPERATIONAL MANEUVER M.S. Thesis
Frank P. Janecek 17 May 1987 62 p
(AD-A184742) Avail: NTIS HC A04/MF A01 CSCL 12B

This monograph examines space doctrine and space operations, and how they support operational maneuver. The concept of operational maneuver is developed with a view to enhancement through space support. Potential space support and ground maneuver enhancement systems are identified. Current methodologies that integrate them into operational maneuver are examined verifying that our doctrine and practice adequately integrate the new systems and capabilities. Recommendations to better integrate space and operational maneuver are presented. The monograph first examines the early development of aviation in an attempt to learn from the early aviation visionaries the ways they integrated aviation into operational maneuver. Their failures and successes are noted. Historical examples of operational maneuver are examined, and inherent key factors are extracted and developed. Doctrinal factors affecting operational maneuver are consolidated and presented. Space doctrine is examined with a view to enhance operational maneuver. Potential space support systems available now to the far term are listed and integrated into operational maneuver; while systemic shortcomings that limit space integration are identified. Finally, recommendations essential to integrate space support and operational maneuver are presented. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-12347# Stanford Linear Accelerator Center, Calif.
PHENOMENOLOGICAL IMPLICATIONS OF THE BLOWN-UP ORBIFOLDS
M. Cvetic May 1987 14 p Presented at the 8th Workshop on Grand Unifications, Syracuse, N.Y., 16 Apr. 1987
(Contract DE-AC03-76SF-00515)
(DE87-014608; SLAC-PUB-4324; CONF-8704204-1) Avail: NTIS HC A03

The structure of the effective Lagrangian for the (2,2) Z(sub N) orbifolds and the corresponding Calabi-Yau manifolds which are obtained by blowing up the orbifold singularities are discussed. The method to blow up such singularities is reviewed. Results are exact at the string tree-level. In particular, the question of generating an intermediate scale M(sub I) in such models is addressed. It is shown that for Z(sub N) orbifolds (except one) and the corresponding blown-up orbifolds which are compactified on any six-torus T sup 6 which can be obtained by continuously deforming T sup 4 circle times T sup 2, all the terms of the type (2727)(sup K) are absent from the effective superpotential, thus questioning the mechanism for generating a large intermediate scale for such compactifications. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-12348# Los Alamos National Lab., N. Mex.
APPLICATIONS OF A THEORY OF FERROMAGNETIC HYSTERESIS
M. L. Hodgdon 1987 25 p Presented at the 6th Conference on the Computation of Electromagnetic Fields, Graz, Austria, 25 Aug. 1987
(Contract W-7405-eng-36)
(DE87-014725; LA-UR-87-2722; CONF-870806-2) Avail: NTIS HC A03/MF A01

The differential equation dB/dt = alpha times the absolute value of dH/dt (f(H) - B) + dH/dt g(H) and a set of restrictions on the material functions f and g yield a theory of rate independent hysteresis for isoperm ferromagnetic materials. A modification based on exchanging the positions of B and H in the differential equation and on allowing for the dependence of the material functions on dH/dt extends the theory to rate dependent, nonisoperm materials. The theory and its extension exhibit all of the important features of ferromagnetic hysteresis, including the existence and stability of minor loops. Both are well suited for use in numerical field solving codes. Examples in which the material functions are simple combinations of analytic functions are presented here for Mn-Zn ferrite, Permalloy, CMD5005, and CoCr thin film. Also presented is a procedure for constructing a two dimensional vector model that yields bell-shaped and M-shaped curves for graphs of the angular variation of the coercive field. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-12349*# Texas Univ., Austin. Applied Research Labs.
APPLICATION OF RAY THEORY TO PROPAGATION OF LOW FREQUENCY NOISE FROM WIND TURBINES Final Report, 20 Jul. 1984 - 30 Sep. 1987
James A. Hawkins Jul. 1987 105 p
(Contract NAS1-17802)
(NASA-CR-178367; NAS 1.26:178367; ARL-TR-87-40) Avail: NTIS HC A06/MF A01 CSCL 20A

Ray theory is used to explain data from two experiments (1985 and 1985) on the propagation of low frequency sound generated by the WTS-4 wind turbine. Emphasis is on downwind data, but some upwind measurements taken during the 1985 experiment are also considered. General ray theory for a moving medium is reviewed and ray equations obtained. Restrictions are introduced simplifying the equations and permitting the use of a ray theory program MEDUSA, the computed propagation loss curve of which is compared to the measurements. Good qualitative agreement is obtained with 1984 downwind data. The results indicate that the downwind sound field is that of a near-ground sound channel. Although more scatter is seen in the 1985 data, agreement between theory and data is also good. In particular, the position and magnitude of the jump in the sound levels associated with the beginning of the sound channel is correctly predicted. The theoretical explanation of the upwind data is less

successful. Ray theory calculations indicate the formation of a shadow zone that, in fact, does not occur. While no sharp shadow zone is apparent in the data, the general expectation (based on ray theory) that sound levels should be much reduced upwind is confirmed by the data. Author

N88-12350# Admiralty Research Establishment, Portland (England).
THE EFFECT OF REVERBERATION ON ACTIVE SONAR PERFORMANCE
M. S. Craig Jun. 1987 114 p
(ARE-TM(UJS)-87104; ACCN-75410; BR102764; ETN-87-90983)
Copyright Avail: NTIS HC A06/MF A01

The performance of an active sonar limited by reverberation is considered, although noise and limitations due to both noise and reverberation are also discussed. If the transmitted pulse is narrowband, the difference between the frequencies scattered by the target and the reverberation due to their different motion relative to the sonar is used to reduce the effect of reverberation. If the transmitted pulse is broadband, the ability of the processor to decrease the response to reverberation emanating from scatterers whose radial distance to the sonar is different from the radial distance to the target is used to reduce the effect of the reverberation. Improvement in performance against reverberation due to the processing is calculated using various assumptions on the nature of the reverberation and the processing. The performance of the sonar given the average signal power, average reverberation power, and noise spectrum level and other quantities related to the assumptions, can be estimated. ESA

N88-12351# European Space Agency, Paris (France).
AN EXPERIMENTAL INVESTIGATION OF NOISE GENERATION AND NOISE REDUCTION IN A PIPE FLOW DOWNSTREAM OF A DISCONTINUOUS AREA ENLARGEMENT
Bernhard Stahl and Gustavo Arguello Jun. 1987 51 p Transl. into ENGLISH of Experimentelle Untersuchung zur Schallerzeugung und Schalldaempfung in einer Rohrstroemung hinter einer Unstetigen Querschnittserweiterung (Goettingen, Federal Republic of Germany) Original language document was previously announced as N87-14959
(ESA-TT-1027; DFVLR-FB-86-27; ETN-87-91113) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 14.50

Flow separation downstream of a discontinuous enlargement in the circular cross-sectional area of a pipe was studied. The turbulence is a source of plane waves and higher acoustical modes. Microphone measurements were made to study the pressure fluctuations in the compact source region of the acoustic waves, and the aerodynamically generated acoustic field behind the discontinuous enlargement is shown to dominate far downstream. The vibrations of the acoustical modes are discussed, and damping techniques using simple geometrical shapes are tested. ESA

N88-12352*# Calspan Advanced Technology Center, Buffalo, N.Y. Physical Sciences Dept.
A HYBRID NUMERICAL TECHNIQUE FOR PREDICTING THE AERODYNAMIC AND ACOUSTIC FIELDS OF ADVANCED TURBOPROPS Final Report
G. F. Homicz and J. R. Moselle Apr. 1985 71 p
(Contract NAS3-23699)
(NASA-CR-174926; NAS 1.26:174926; Calspan-7157-A-1) Avail: NTIS HC A04/MF A01 CSCL 20A

A hybrid numerical procedure is presented for the prediction of the aerodynamic and acoustic performance of advanced turboprops. A hybrid scheme is proposed which in principle leads to a consistent simultaneous prediction of both fields. In the inner flow a finite difference method, the Approximate-Factorization Alternating-Direction-Implicit (ADI) scheme, is used to solve the nonlinear Euler equations. In the outer flow the linearized acoustic equations are solved via a Boundary-Integral Equation (BIE) method. The two solutions are iteratively matched across a fictitious interface in the flow so as to maintain continuity. At convergence the resulting aerodynamic load prediction will automatically satisfy the appropriate free-field boundary conditions at the edge of the finite difference grid, while the acoustic predictions will reflect the back-reaction of the radiated field on the magnitude of the loading source terms, as well as refractive effects in the inner flow. The equations and logic needed to match the two solutions are developed and the computer program implementing the procedure is described. Unfortunately, no converged solutions were obtained, due to unexpectedly large running times. The reasons for this are discussed and several means to alleviate the situation are suggested. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-12353* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SIMPLIFIED CARS MEASUREMENT SYSTEM FOR RAPID DETERMINATION OF TEMPERATURE AND OXYGEN CONCENTRATION
Shoichi Fujii Aug. 1987 32 p
(NASA-TM-100498; NAS 1.15:100498) Avail: NTIS HC A03/MF A01 CSCL 20H

A new spectroscopic concept for the rapid determination of temperature and oxygen concentration by CARS (Coherent Anti-Stokes Raman Spectroscopy) was described. The ratio of two spectral regions in the broadband Q-branch spectrum was detected by photomultipliers in a monochromator, which ratio depends on temperature and species concentration. The comparison of the measured data with theory was made using a flat flame burner and an electric furnace, with reasonable results. Various optical techniques for alignment were introduced including a highly efficient, stable dye oscillator. The combination of the spectroscopic concept and the optical techniques will make the CARS measurement system rapid in data processing and simple in optical parts. Author

N88-12354# Johns Hopkins Univ., Baltimore, Md.
THE CONFERENCE ON THE DYNAMICS OF MOLECULAR COLLISIONS HELD IN OGLEBAY PARK, WHEELING, WEST VIRGINIA ON 12-17 JULY 1987 Final Report
Paul J. Dagdigian 17 Jul. 1987 222 p Conference held in Wheeling, W. Va., 12-17 Jul. 1987
(Grant DAAL03-87-G-0096)
(AD-A184690; ARO-24892.1-CH-CF) Avail: NTIS HC A10/MF A01 CSCL 07D

The proceedings for the 1987 Conference on the Dynamics of Molecular Collisions, which was held in Oglebay Park, near Wheeling, WV, on July 12-17, is attached. There were formal sessions on both experimental and theoretical aspects of reactive collisions, inelastic energy transfer processes, and gas-surface interactions, as well as special session on photodissociation and van der Waals molecules. There were 240 participants registered for the meetings, and 165 contributed papers were presented in several poster sessions. GRA

N88-12355# Los Alamos National Lab., N. Mex.
APPLIED NUCLEAR SCIENCE RESEARCH AND DEVELOPMENT Progress Report, 1 Dec. 1985 - 30 Jun. 1986
E. D. Arthur, comp. and A. D. Mutschlecner, comp. Feb. 1987 132 p
(Contract W-7405-eng-36)
(LA-10915-PR) Avail: NTIS HC A07/MF A01

Activities of the Los Alamos Applied Nuclear Science Group are summarized. The topical content includes research in the following areas: theory and evaluation of nuclear cross sections; nuclear cross section processing and testing; neutron activation, fission products, and actinides; and applications. M.G.

N88-12356# Stanford Linear Accelerator Center, Calif.
ON CHARM DECAYS: PRESENT STATUS AND FUTURE GOALS
I. I. Bigi Jun. 1987 45 p Presented at the Charm Physics Symposium, Beijing, China, 4 Jun. 1987
(Contract DE-AC03-76SF-00515)
(DE87-013586; SLAC-PUB-4349; CONF-8706185-2) Avail: NTIS HC A03/MF A01

After a qualitative introduction into the dynamics underlying charm decays the author describes in some detail three different theoretical treatments: the Stech et al. description based on factorization, the 1/N approach and an ansatz employing QCD sum rules. The overall agreement of the emerging theoretical picture with the data is rather encouraging and indicates that the effects of hadronization on these decays are under reasonable control. Yet more and more detailed data are needed to confirm (hopefully) this simple picture. The author lists the processes most relevant in this respect and emphasizes the need for increasing our theoretical sophistication. Once this is achieved we have on one hand acquired the theoretical tools to deal with B physics; on the other hand we will then be ready to exploit charm physics to the fullest in searching for exotic D decays, D^0 - anti D^0 mixing and CP violation. DOE

N88-12357# Los Alamos National Lab., N. Mex.
PHYSICS OF FEW-BODY LAMBDA HYPERNUCLEI
B. F. Gibson 1987 20 p Presented at the International Symposium on Strangeness in Hadronic Matter, Bad Honnef, Fed. Republic of Germany, 1 Jun. 1987 Prepared in cooperation with Flinders Univ. of South Australia, Bedford Park
(Contract W-7405-eng-36)
(DE87-014746; LA-UR-87-2892; CONF-8706212-2) Avail: NTIS HC A03/MF A01

The energies of the particle-stable states in few-body Lambda hypernuclei are summarized. Other topics reviewed include: the role of the hypertriton in determining the spin dependence of the Lambda Nu force, the role of the hypertriton in three-body force investigations, the effect of medium modifications upon Lambda Nu-Sigma Nu coupling in the Lambda-4 isodoublet and the spin dependence of the Lambda-Nu force, the importance of exact equation formalisms in interpreting precision data, and the need for a renewed effort to identify and measure the masses of hyperfragments. DOE

N88-12358# Simon Fraser Univ., Burnaby (British Columbia). Dept. of Physics.
COMPUTER SIMULATIONS OF FRAGMENTATION
G. E. Beauvais, D. H. Boal, and J. Glosli Apr. 1987 11 p Presented at the 193rd National Meeting of the American Chemical Society, Denver, Colo., 5 Apr. 1987
(DE87-900985; TRI-PP-87-45; CONF-870410-38) Avail: NTIS (US Sales Only) HC A03

A semiclassical model for describing nuclear reactions at intermediate energy is presented. The model is applied to the study of fragmentation in proton and heavy ion induced reactions. Computer simulations based on the model allow one to follow the evolution of the reactions in both coordinate and phase space. The reaction trajectories are found to be influenced by the existence of a mechanical instability region at a density of less than half normal nuclear matter density. DOE

N88-12359# Oak Ridge National Lab., Tenn.
DEVELOPMENT AND EVALUATION OF A MONTE CARLO CODE SYSTEM FOR ANALYSIS OF IONIZATION CHAMBER RESPONSES
J. O. Johnaon and T. A. Gabriel Jul. 1987 120 p Sponsored in part by Defense Nuclear Agency. Washington, D.C.
(Contract DE-AC05-84OR-21400)
(AD-A183970; ORNL/TM-10196) Avail: NTIS HC A06/MF A01 CSCL 18D

The purpose of this work is the development and testing of a Monte Carlo code system for calculating the response of an ionization chamber to a mixed neutron and photon radiation environment. The resulting code system entitled MICAP - a Monte Carlo Ionization Chamber Analysis Package - determines the neutron, photon, and total responses of the ionization chamber to the mixed field radiation environment. The Monte Carlo method performs accurate simulations of the physical processes involved in detecting radiation using ionization chambers, and eliminates limitations inherent in approximate methods. To evaluate MICAP, comparisons were made with results obtained using other code systems and with experimental results. Separate comparisons with other code systems verified the validity of the neutron, photon, and charged particle transport processes and the nuclear models used to describe the individual neutron reactions, respectively. Comparisons with mono-energetic photon calibration experiments and with mixed neutron and photon radiation experiments verified the applicability of MICAP for analyzing the response of ionization chambers to mixed field radiation environments. GRA

N88-12360# Oakland Univ., Rochester, Mich. Dept. of Chemistry.
MONTE CARLO SIMULATION OF PRIMITIVE ATOM-TRANSFER REACTIONS IN SOLUTION
P. P. Schmidt and Lester Blum Jul. 1987 50 p
(Contract N00014-77-C-0239)
(AD-A183977; TR-26) Avail: NTIS HC A03/MF A01 CSCL 07D

This work develops a computational algorithm which combines saddle point and Metropolis/Monte Carlo optimization to investigate reactions in solution; the reactions involve atom transfer on an adiabatic potential energy surface. The value of the rate constant is calculated in the form of the simple Arrhenius equation for the jump rate nu, nu = less than omega greater than exp (-(less than superscript F greater than - less than E sub o greater than /kT), in which less than E superscript F greater than is the average energy of the transition state, less than E sub o greater than is the average energy of the initial state, and less than omega greater than is the average frequency of passage through the transition state. Individual configurations in the Metropolis sample allow either for passage of the reactive species over the top of the barrier or tunnelling through the barrier. The average frequency less than omega greater than reflects this situation. Because the Metropolis sampling method deals with discrete collections of particles, with specified forces of interaction, the transfer frequencies for over-the-top of the barrier and tunnel transfers can be determined in terms of the actual interactions used instead of using non-specific, model potential energy functions for the barrier. GRA

N88-12361# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
DYNAMICS OF ATOMS IN LOW-SYMMETRY SYSTEMS
R. M. Nieminen Jul. 1987 29 p
(Contract N00014-82-K-0576)
(AD-A184318; TR-33) Avail: NTIS HC A03/MF A01 CSCL 20L

Recent ideas to extend the scope and applicability of large-scale computer simulation of condensed phases are discussed. These include (1) the use of simulated annealing and related methods in first-principles calculations and (2) the development effective-medium and similar approximate approaches to interatomic interactions in low-symmetry situations. Examples of applications to molecular dynamics simulations are presented. GRA

N88-11892# Joint Publications Research Service, Arlington, Va.
GENERATION OF IR STIMULATED RADIATION, UV VISIBLE VIOLET COHERENT RADIATION BY TWO-PHOTON RESONANCE PUMPING IN K VAPOR
Zugeng Wang, Xiaoling Tang, Kiachang Zhang, and Yishan Zheng *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 14-24 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6 no. 12, Dec. 1986 p 1063-1070 (For primary document see N88-11888 03-31)

03-31)
Avail: NTIS HC A06/MF A01

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-12362# Los Alamos National Lab., N. Mex.
GENERAL-PURPOSE HEAT SOURCE SAFETY VERIFICATION TEST PROGRAM: EDGE-ON FLYER PLATE TESTS
T. G. George Mar. 1987 24 p
(Contract W-7405-eng-36)
(DE87-006309; LA-10872-MS) Avail: NTIS HC A03/MF A01

The radioisotope thermoelectric generator (RTG) that will supply power for the Galileo and Ulysses space missions contains 18 General-Purpose Heat Source (GPHS) modules. The GPHS modules provide power by transmitting the heat of Pu-238 alpha-decay to an array of thermoelectric elements. Each module contains four Pu-238O2-fueled clads and generates 250 W(t). Because the possibility of a launch vehicle explosion always exists, and because such an explosion could generate a field of high-energy fragments, the fueled clads within each GPHS module must survive fragment impact. The edge-on flyer plate tests were included in the Safety Verification Test series to provide information on the module/clad response to the impact of high-energy plate fragments. The test results indicate that the edge-on impact of a 3.2-mm-thick, aluminum-alloy (2219-T87) plate traveling at 915 m/s causes the complete release of fuel from capsules contained within a bare GPHS module, and that the threshold velocity sufficient to cause the breach of a bare, simulant-fueled clad impacted by a 3.5-mm-thick, aluminum-alloy (5052-TO) plate is approximately 140 m/s. DOE

N88-12363# Northwestern Univ., Evanston, Ill.
HIGH ENERGY EXPERIMENTAL PHYSICS Progress Report
J. Rosen 1987 171 p
(Contract DE-AC02-76ER-02289)
(DE87-013516; DOE/ER-02289/T5) Avail: NTIS HC A08

This report discusses experiments done at Fermilab. Studies are done on the production of charm particles in hadronic interactions, drift chambers, Fastbus routines and microcodes for high energy physics experimental application. Also budget and future experimental proposals are considered. DOE

74 OPTICS

Includes light phenomena; and optical devices.

For lasers see *36 Lasers and Masers.*

N88-12364# National Bureau of Standards, Boulder, Colo. Electromagnetic Technology Div.
IMAGE PROCESSING FOR OPTICAL ENGINEERING APPLICATIONS
M. B. Weppner and M. Young Apr. 1987 105 p
(PB87-210035; NBSIR-87/3065) Avail: NTIS HC A06/MF A01 CSCL 20F

This Internal Report describes the development and testing of image processing software designed for optical engineering applications. Image processing functions in this software include two-dimensional Fourier transforms, convolution, noise reduction, multiple image resolutions, and low-level image processing functions. The software also contains image information display tools including Gaussian beam and g-profile characterization for optical fiber measurements. The necessary image file input/output routines are presented in the software and are used to read and store images in conjunction with other image processing software, digitizing cameras, and output display devices. GRA

N88-12365# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
24 Jul. 1987 119 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-032) Avail: NTIS HC A06/MF A01

Translated Chinese articles from various periodicals are presented. Most of the journal is devoted to Applied Sciences and National Developments, however, a few articles are on Earth Sciences. The only article of interest to NASA is entitled Four-Wave Mixing Used in Optical Amplitude Encoding. For individual titles, see N88-12366 through N88-12366.

N88-12366# Joint Publications Research Service, Arlington, Va.
FOUR-WAVE MIXING USED IN OPTICAL AMPLITUDE ENCODING
Siji Guo and Xiaodong Zeng *In its* JPRS Report: Science and Technology. China 24 Jul. 1987 p 7-14 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, People's Republic of China), v. 7, no. 1, Jan. 1987 p 92-96 (For primary document see N88-12365 03-74)
Avail: NTIS HC A06/MF A01

The viability of using transient four-wave mixing (TFWM) in optical amplitude modulated encoding is discussed. An effective numerical method is given to solve coupled wave equations with discontinuous solutions and the effect of system parameters on signal quality is studied. The results show that a four-wave mixing system can form a high speed encoding converter and thereby provide a new means for ultra short pulse high speed encoding.
Author

N88-12367# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
THE FORMATION OF OPTICAL MEMBRANE REFLECTOR SURFACES USING UNIFORM PRESSURE LOADING
L. M. Murphy and C. Tuan Aug. 1987 54 p Prepared in cooperation with Nebraska Univ., Lincoln
(Contract DE-AC02-83CH-10093)
(DE87-012275; SERI/TR-253-3025) Avail: NTIS HC A04/MF A01

Potentially high quality optical reflector surfaces are attainable with the use of pressure formed membranes. Such reflector surfaces offer the prospect of very low weight and low cost. The formation of such surfaces, using initially flat circular membranes with uniform pressure loading, is studied. Finite axisymmetric deformations, along with both linear and nonlinear material response is considered. A wide range of focal-length-to-diameter ratios (above 0.6) are addressed and the structural/optical response mechanisms that lead to optical distortions relative to ideal parabolic reflector shapes are also considered. Results show that elastic material response can often lead to a significantly larger deviation from the ideal shape than will inelastic material response. This results primarily from the ability to limit stress nonuniformities when inelastic material response is operative. Furthermore, when under pressure loading the membrane focal length decreases monotonically with increasing radius for both linear and nonlinear material response. Further, the predicted focal length variation is increasingly nonlinear near the membrane support. DOE

N88-12368# Lawrence Livermore National Lab., Calif.
LIGHT SCATTERING BY ORIENTED AND RANDOMLY DISPERSED CHIRAL PARTICLES
Shermila Brito Singham 1987 11 p Presented at the CRDEC Scientific Conference on Obscuration and Aerosol Research, Aberdeen, Md., 1 Jun. 1987
(Contract W-7405-eng-36)
(DE87-014758; LA-UR-87-2851; CONF-8706199-1) Avail: NTIS HC A03/MF A01

The use of coupled dipoles in modelling light scattering by oriented and randomly dispersed chiral particles is examined in this paper. The chirality considered here is from chirality which results from macroscopic structural mirror asymmetry in the particle. For a chiral particle described by spherical dipoles, it is shown

that large magnitude terms that contribute the chiral matrix elements of an oriented particle do not contribute at all in the orientation average. This result will be used in future work to obtain a more efficient method of evaluating light scattering by randomly dispersed chiral particles. DOE

N88-12369# Columbia Univ., New York, N.Y. Dept. of Electrical Engineering.
INTEGRATED FIBER-OPTIC COUPLER Annual Report, Jun. 1985 - Jun. 1986
P. R. Prucnal and E. R. Fossum Apr. 1987 29 p
(Contract N66001-85-C-0258)
(AD-A184494; NOSC-TD-1086) Avail: NTIS HC A03/MF A01 CSCL 20F

This report describes a silicon photodetector structure exhibiting real-estate efficient coupling of optical fibers to semiconductors. The integrated fiber-optic coupler employs a vertical insertion of a tapered single-mode fiber into a laser-etched cylindrical hole in a semiconductor substrate. It features a small surface footprint, mechanical stability, and accurate alignment. The p-n junction detectors have typically shown responsivities of 0.23 A/W at 0.63 micron, corresponding to a quantum efficiency of 45 percent, and dark currents below 1nA. Author (GRA)

N88-12370# Naval Postgraduate School, Monterey, Calif.
SURFACE POLARITON RESONANCES AND REFLECTANCE ON A BIGRATING M.S. Thesis
Gary J. Melendez Jun. 1987 128 p
(AD-A184663) Avail: NTIS HC A07/MF A01 CSCL 20C

A first order perturbation theory for treatment of the diffraction of light with surface polariton resonances on a bigrating has previously been developed and implemented. A modification has since been developed to include simultaneous resonant coupling to four surface polaritons. This work implements the modification and compares the results against exact theory. Results for reflectance versus angle of incidence were obtained for a sinusoidal bigrating of silver with a period of 615.47 nm and an incident wavelength of 633.00 nm. The perturbation theory is found to be valid at off-normal incidence for grating height to period ratios of 0.024 and less. GRA

N88-12371# Naval Postgraduate School, Monterey, Calif.
AN APPLICATION OF A GRADIENT RELAXATION METHOD TO NOISY INFRARED IMAGES M.S. Thesis
James C. McDougall Jun. 1987 119 p
(AD-A184666) Avail: NTIS HC A06/MF A01 CSCL 17E

Image segmentation is an essential preliminary step in automatic pictorial pattern recognition and scene analysis problems. The objective of segmentation techniques is to partition an image into regions or components. The purpose of this thesis is to analyze a segmentation technique called gradient relaxation. The latter is a viable method in segmenting objects within an image. The gradient relaxation technique is applicable to images having unimodal distributions. This method is applied to noisy infrared images in an attempt to detect and classify the target. The method allows for an easy selection of threshold value which may be required for other types of image processing on the image. The main issue is to examine the effectiveness of this technique applied to noisy infrared images from uncooled focal plane array sensor having unimodal distributions. The technique was able to extract the target in the image, producing a homogeneous and uniform region for most of the cases studied. A target which was fragmented into several parts because of the noise is not detectable. The technique could be implemented in hardware and applied to the inputs of a classification system for detectable objects in noisy infrared images. GRA

N88-12372# Naval Postgraduate School, Monterey, Calif.
DETERMINATION OF THE ORIGIN OF SELF-PUMPED PHASE CONJUGATION IN BARIUM TITANATE M.S. Thesis
Thomas R. Moore Jun. 1987 98 p
(AD-A184697) Avail: NTIS HC A05/MF A01 CSCL 20B

When a beam of extraordinarily polarized light is directed through a poled, single crystal of barium titanate it fans in the direction of the optic axis. This thesis research investigates the origin of this fanning, or asymmetric self-defocusing, in barium titanate. Experimental observations and theoretical simulation suggest that this phenomenon is due to near forward stimulated photorefractive scattering. Additionally, observations of unique variegated beam patterns during phase conjugation are reported, including internally pumped rings and motion invariant patterns. GRA

N88-12154# Centre National d'Etudes Spatiales, Toulouse (France).
INTRINSIC AND EXTRINSIC GEOMETRIC QUALITY
B. Boissin and J.-P. Gardelle *In its* SPOT 1: First In-Flight Results 1987 p 83-91 (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-12373# Lawrence Livermore National Lab., Calif.
APPLICATION OF A TWO FLUID THEORETICAL PLASMA TRANSPORT MODEL ON CURRENT TOKAMAK REACTOR DESIGNS
E. Ibrahim and T. K. Fowler Jun. 1987 7 p Presented at the Annual Meeting of the American Nuclear Society, Dallas, Tex., 7 Jun. 1987
(Contract W-7405-eng-48)
(DE87-013511; UCRL-96898; CONF-870601-22) Avail: NTIS HC A02/MF A01

In this work, the new theoretical transport models to TIBER II design calculations are described and the results are compared with recent experimental data in large Tokamaks (TFTR, JET). Tang's method is extended to a two-fluid model treating ions and electrons separately. This allows for different ion and electron temperatures, as in recent low-density experiments in TFTR, and in the TIBER II design itself. The discussion is divided into two parts: (1) Development of the theoretical transport model and (2) calibration against experiments and application to TIBER II. DOE

N88-12374# Los Alamos National Lab., N. Mex.
ENERGY CASCADING IN THE BEAT-WAVE ACCELERATOR
C. J. McKinstrie and S. H. Batha 1987 16 p Presented at the Workshop on New Developments in Particle Acceleration Techniques, Orsay, France, 29 Jun. 1987 Prepared in cooperation with Rochester Univ., N.Y.
(Contract W-7405-eng-36)
(DE87-014727; LA-UR-87-2714; CONF-8706147-6) Avail: NTIS HC A03/MF A01

A review is given of energy cascading in the beat-wave accelerator. The properties of the electromagnetic cascade and the corresponding plasma-wave evolution are well understood within the framework of an approximate analytic model. Based on this model, idealized laser-plasma coupling efficiencies of the order of 10% do not seem unreasonable. DOE

N88-12375# Los Alamos National Lab., N. Mex.
A TAPERED POLOIDAL GAP FOR THE REDUCTION OF FIELD ERRORS
R. W. Moses 1987 7 p Presented at the Reversed Field Pinch Workshop, Los Alamos, N. Mex., 13 Jul. 1987
(Contract W-7405-eng-36)
(DE87-014750; LA-UR-87-2875; CONF-8707105-1) Avail: NTIS HC A02/MF A01

The conventional Reversed Field Pinch is surrounded by a toroidal conducting shell that provides wall stabilization for the plasma. Usually, this shell is made of aluminum or copper, and it

must have an insulated poloidal gap to permit penetrations of toroidal loop voltage to the plasma. Many magnetic field perturbations will induce toroidal shell currents with poloidal Fourier components having mode numbers m greater than or = 1. A butt-joint poloidal gap will mode convert all of these image currents into potentially damaging magnetic-field errors with large spectra of toroidal-mode numbers. Overlapping tapered gaps have been proposed and partially tested for reducing these field errors. The mathematical basis for minimizing the m = 1, n = 0 field errors for all frequencies using tapered gaps, is presented. DOE

N88-12376# Los Alamos National Lab., N. Mex.
HELICITY DISSIPATION IN THE PLASMA EDGE
R. A. Nebel 1987 6 p Presented at the Course and Workshop on Physics of Mirrors, Reversed Field Pinches and Compact Tori, Varenna, Italy, 1-11 Sep. 1987
(Contract W-7405-eng-36)
(DE87-014762; LA-UR-87-2830; CONF-870908-4) Avail: NTIS HC A02/MF A01

Three dimensional MHD simulations were done to test the conjecture that the cause of the increased loop voltage observed in certain RFP experiments is helicity dissipation in the highly resistive edge plasma region. The simulations were done with a 3-D nonlinear, 0-beta resistive MHD code. The Lundquist number for the simulations was S = 10 to the 4th power. Resistivity was increased by a factor of 100 in the edge region. DOE

N88-12377# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
MATHEMATICAL MODELS OF PLASMA DISCHARGE CONTROL IN A TOKAMAK
V. F. Andreev, Yu. N. Dnestrovskij, D. P. Kostomarov, and A. M. Popov 1985 28 p In RUSSIAN
(DE87-702891; IAE-4214/7) Avail: NTIS (US Sales Only) HC A03/MF A01

A model for program description of discharge development in a tokomak is considered and the problem of optimal control of poloidal fields and total current in plasma is determined. A comparison of the formulated problem solution methods is performed. A quasi-optimal control model is proposed, allowing one to take account of real power supplies. Analysis of the control task stability and correctness is conducted. The numerical code for optimal control task solution is developed and the method is described. Different operation modes of the T-15 device are calculated using the developed code. DOE

N88-12378# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskij Inst.
EFFECT OF ELECTROSTATIC FIELD ON BEHAVIOUR OF PERIPHERIC PLASMA AT HIGH-FREQUENCY HEATING
L. L. Grigoreva, B. I. Smerdov, and V. V. Chechkin 1986 20 p In RUSSIAN
(DE87-703328; KFTI-86-13) Avail: NTIS (US Sales Only) HC A03/MF A01

One of the possible mechanisms resulting in increased separation of impurities under plasma HF heating in tokamaks and stellarators in the range of Alfven and ion cyclotron frequencies is studied. Potential guidance in limited plasma and development of particle currents in bound layers under the effect of an external variable electrostatic field is considered. An investigation was carried out for two of the simplest models - plasma between two parallel electrodes and plasma filaments between two grounded electrodes in a longitudinal magnetic field (in the latter case experimentally). The results obtained permit a better understanding of the polarization processes occurring under the effect of HF-electrostatic fields in complex systems. On the one hand these processes should result in removal of peripheral plasma particles on the wall of the chamber, limiters, antennas, and, on the other hand, in increased separation of impurities due to material sputtering of these details by ions accelerated in bound layers. DOE

N88-12379# Sandia National Labs., Albuquerque, N. Mex.
ANALYTIC MODEL OF AN IMPLODING Z-PINCH PLASMA COLLIDING INELASTICALLY WITH A THIN-SHELLED CYLINDRICAL TARGET
Thomas W. Hussey Sep. 1987 31 p
(Contract DE-AC04-76DP-00789)
(DE88-000051; SAND-87-1748) Avail: NTIS HC A03/MF A01

A simple model for the target dynamics of a distributed, uniform density imploding gas puff plasma colliding with a thin, annular, cylindrical shell has been developed. This model is applicable to a pulse-power-driven, photoionization-pumped, recombination X-ray laser. By integrating the equation for momentum conservation it was possible to obtain target closure time, a quantity that may be compared to experiment. In addition, it was possible to find energy available as pump radiation as a function of target parameters. We find that this quantity is maximized when target mass approximately equals the gas mass times the thickness of the gas puff prior to stagnation divided by twice the target radius. We also find that this quantity is a relatively weak function of gas puff shell thickness prior to stagnation, a somewhat stronger function of target mass, and a very strong function of implosion velocity. DOE

N88-12380# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
MEASUREMENT OF PARALLEL ION ENERGY DISTRIBUTION FUNCTION IN PISCES PLASMA
G. R. Tynan, D. M. Goebel, R. W. Conn, B. LaBombard, Y. Hirooka, and W. K. Leung Aug. 1987 44 p
(Contract DE-FG03-86ER-52134)
(DE88-000108; UCLA-PPG-1092) Avail: NTIS HC A03/MF A01

The PISCES facility is used to conduct controlled plasma-surface interaction experiments. Plasma parameters typical of those found in the edge plasmas of major fusion confinement experiments are produced. In this work, the energy distribution of the ion flux incident on a material surface is measured using a gridded energy analyzer in place of a material sample. The full width at half maximum energy distribution of the ion flux is found to vary from 10 eV to 30 eV for both hydrogen and deuterium plasmas. Helium plasmas have a much lower FWHM energy spread than hydrogen and deuterium plasmas. The FWHM ion energy spread is found to be linearly related to the electron temperature. The most probable ion energy is found to be linearly related to the bias applied to the energy analyzer. Other plasma parameters have a weak influence on the energy distribution of the ion flux. Two possible physical mechanisms for producing the observed results are introduced and suggestions for further work are made. The impact of the reported measurements on the materials experiments conducted in the PISCES facility are discussed and recommendations for future experiments made. DOE

N88-12381# Wisconsin Univ., Madison. Plasma Physics Research.
INTERCHANGE STABILITY OF NONCIRCULAR REVERSED FIELD PINCHES
Darrell A. Skinner, S. C. Prager, and A. M. M. Todd (Grumman Aerospace Corp., Princeton, N.J.) Aug. 1987 20 p
(Contract DE-FG02-85ER-53212)
(DE88-000177; DOE/ER-53212/110) Avail: NTIS HC A03/MF A01

Interchange (Mercier) stability of toroidal reversed-field-pinch plasmas with noncircular cross-section is evaluated numerically. Marginally stable pressure profiles and beta values are produced. Most shapes, such as indented or vertically elongated, reduce stability by making the net magnetic curvature of the poloidal-field-dominated plasmas yet worse than that of the circle. Horizontally elongated plasmas slightly enhance stability beyond that of the circle as a result of increased shear produced by toroidicity. Such shear enhancement by the toroidal shift of magnetic surfaces might be exploited for future, more comprehensive studies. DOE

N88-12382# Oak Ridge National Lab., Tenn.
APPLICATIONS OF NEUTRAL BEAM AND RF TECHNOLOGIES
H. H. Haselton Apr. 1987 15 p Presented at the Annual Meeting of Fusion Power Associates, Pleasanton, Calif., 8 Apr. 1987
(Contract DE-AC05-84OR-21400)
(DE87-014936; CONF-870457-4) Avail: NTIS HC A03/MF A01

This presentation provides an update on the applications of neutral beams and radiofrequency (rf) power in the fusion program; highlights of the ion cyclotron heating (ICH) experiments now in progress, as well as the neutral beam experiments; and heating requirements of future devices and some of the available options. Some remarks on current drive are presented because this area of technology is one that is being considered for future devices. DOE

N88-12383# Texas Univ., Austin. Inst. for Fusion Studies.
STABILITY OF LOW-SHEAR TOKAMAKS
F. L. Waelbroeck and R. D. Hazeltine Sep. 1987 19 p
(Contract DE-FG05-80ET-53088)
(DE88-000305; DOE/ET-53088/298; IFSR-298) Avail: NTIS HC A03/MF A01

It has been suggested that the recently observed fast sawtooth crashes are caused by a low-shear, pressure-driven ideal instability. This hypothesis is investigated, using asymptotic methods to solve the toroidal mode equations for a class of equilibria characterized by a low-shear central region in which q - 1 is small, separated from the wall by a region with finite shear. A dispersion relation which differs significantly from previous results is obtained. An explicit expression for the growth rate is given for a model q profile. DOE

N88-12384# Lawrence Livermore National Lab., Calif.
ANALYSIS OF AN INDUCTION LINAC DRIVER SYSTEM FOR INERTIAL FUSION
J. Hovingh, V. O. Brady, A. Faltens, D. Keefe, and E. P. Lee Jul. 1987 39 p Prepared in cooperation with California Univ., Berkeley, Lawrence Berkeley Lab.
(Contract DE-AC03-76SF-00098)
(DE88-000681; LBL-22713) Avail: NTIS HC A03/MF A01

A linear induction accelerator that produces a beam of energetic (5 to 20 GeV) heavy (130 to 210 amu) ions is a prime candidate as a driver for inertial fusion. Continuing developments in sources for ions with charge state greater than unity allow a potentially large reduction in the driver cost and an increase in the driver efficiency. The use of high undepressed tunes (sigma approx. = 85°) and low depressed tunes (sigma approx. = 8.5°) also contributes to a potentially large reduction in the driver cost. The efficiency and cost of the induction linac system are discussed as a function of output energy and pulse repetition frequency for several ion masses and charge states. The cost optimization code LIACEP, including accelerating module alternatives, transport modules, and scaling laws, is presented. Items with large cost-leverage are identified as a guide to future research activities and development of technology that can yield substantial reductions in the accelerator system cost and improvement in the accelerator system efficiency. Finally, a cost-effective strategy using heavy ion induction linacs in a development scenario for inertial fusion is presented. DOE

N88-12385# Systems Science and Software, La Jolla, Calif.
THE EFFECT OF OBJECT POTENTIALS ON THE WAKE OF A FLOWING PLASMA
I. Katz, M. J. Mandell, D. E. Parks, K. Wright, and N. H. Stone Dec. 1986 33 p
(Contract F19628-86-C-0056)
(AD-A184038; SSS-R-87-8473; AFGL-TR-87-0023; SR-3) Avail: NTIS HC A03/MF A01 CSCL 20I

Measurements and calculations have been carried out to determine the structure of electric potential and ion density in the near wake created by the flow of a high Mach number plasma past a conduction plate biased with respect to the undisturbed plasma. Results are obtained for a molecular nitrogen plasma with ambient electron densities N of order 100,000/cc, ion temperatures Theta sub i approx. = 0.025eV, electron temperatures Theta approx. 0/3eV, and plasma flow velocities sub theta approx. = 1,000,000 cm/sec, corresponding to sub theta sq rt (Theta/M) approx.= 11. For high Mach number flow past an unbiased object, the wake structure is very nearly that predicted for the expansion of an initially uniform plasma half space into vacuum; in this case there is a sharply defined ion front moving under the influence of an electric field produced by charge separation between ions and electrons near the front. With bias potential in the range -1 to -10, a well defined ion front still exists, but its motion is strongly affected by the imposed potential. This effect can be explained in terms of the impulse received by those ions passing through the sheath region near the plate edge. Two dimensional simulations of the lab experiments were performed using a multiple waterbag technique. The results for both zero and finite ion temperatures are almost noise free, and support the approximate analytical model. GRA

N88-11703 Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
ELEMENTS OF PLASMA PHYSICS [ELEMENTS DE PHYSIQUE DES PLASMAS]
A. Saint-Marc and D. LeQueau *In* CNES, Space Environment Technology Apr. 1987 p 13-52 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11710 Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
HOT PLASMAS IN THE EARTH'S MAGNETOSPHERE [PLASMAS CHAUDS DANS LA MAGNETOSPHERE TERRESTRE]
J. M. Bosqued *In* CNES, Space Environment Technology Apr. 1987 p 209-247 In FRENCH (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-12019# Gunma Univ., Maebashi (Japan). Faculty of Engineering.
NONEQUILIBRIUM CHARACTERISTICS OF NITROGEN PLASMAS APPROPRIATE TO AN AOTV FLIGHT
Hiroyuki Shirai *In* Tokyo Univ., The Proceedings of the Symposium on Mechanics for Space Flight Mar. 1987 p 155-163 (For primary document see N88-12006 03-34)
Avail: NTIS HC A09/MF A01

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-12386# Los Alamos National Lab., N. Mex.
A ROLE FOR NATIONAL LABORATORIES IN ENHANCING ECONOMIC COMPETITIVENESS. THE EXAMPLE OF HIGH-TEMPERATURE SUPERCONDUCTORS: CNSS PAPERS, NO. 1
S. S. Hecker Jul. 1987 18 p
(Contract W-7405-eng-36)
(DE87-013633; LA-11092-MS) Avail: NTIS HC A03/MF A01

The basic research community is responding splendidly in pushing the limits of superconductivity. The race to commercialize these new materials is on. The US will face unprecedented international competition, especially from the Japanese. The US needs to develop a partnership among universities, federal laboratories, and private industry. Universities have begun to team with industry while some of the large industrial companies like AT and T and IBM are competing effectively. But it will take more to make the mainstream of US industry competitive. Therefore, an initiative is proposed to develop an industry-DOE national laboratory partnership by establishing Exploratory R and D Centers at these laboratories. The centers will concentrate on the R and D for

enabling technologies required to commercialize high-temperature superconductors. This initiative will in part help US industry to be competitive in this new and exciting field. DOE

N88-12387# Sandia National Labs., Albuquerque, N. Mex.
SHOCK-INDUCED CHEMICAL SYNTHESIS OF PHASES SIMILAR TO THE HIGH TEMPERATURE SUPERCONDUCTOR OXIDES
B. Morosin, R. A. Graham, E. L. Venturini, D. S. Ginley, and W. F. Hammetter 1987 5 p Presented at the 5th Topical Conference of the American Physical Society on Shockwaves in Condensed Matter, Monterey, Calif. 20 Jul. 1987
(Contract DE-AC04-76DP-00789)
(DE87-013725; SAND-87-0937C; CONF-870753-75) Avail: NTIS HC A02

Various mixtures of metal oxides of compositions which when furnace reacted will yield known high temperature superconductor oxides have been subjected to a range of shock loading conditions to determine parameters leading to their shock-induced chemical synthesis. Recovered samples show x-ray diffraction lines consistent with the formation of the K2NiF4 structure type crystallographic phase for La/sub 1.85/Sr/sub 0.15/CuO4. Studies on the YBaCu system yielded diffraction lines consistent with those for a small amount of YBa2Cu3O7. DOE

N88-12388# California Univ., Berkeley. Lawrence Berkeley Lab.
SPECIFIC HEAT OF THE HIGH T/SUB c SUPERCONDUCTORS (La,M)2CuO4 AND YBa2Cu3O7 IN MAGNETIC FIELDS
N. E. Phillips, R. A. Fisher, S. E. Lacy, C. Marcenat, J. A. Olsen, W. K. Ham, A. M. Stacy, J. E. Gordon, and M. L. Tan Aug. 1987 10 p Presented at the 18th Conference on Superconductivity in Highly Correlated Fermion Systems, Sendai, Japan, 31 Aug. 1987
(Contract DE-AC03-76SF-00098)
(DE87-014680; LBL-23872; CONF-870881-1) Avail: NTIS HC A02/MF A01

The specific heats, C, of the high T(sub c) superconductors YBa2Cu1O7, La(sub 1.85)Ca(sub 0.15)CuO4 and La(sub 1.85)Sr(sub 0.15)CuO4 have been measured from 0.4K to above the superconducting transition temperature in magnetic fields, H, from 0 to 7T. From measured changes in C with H, values of gamma (H) = (C(H)/T) sub T=0 and delta C/T sub c =((C sub s -C sub n)/T) sub T=T(sub c) have been evaluated. These results have been used to estimate the normal state gamma, the fraction of the sample that is superconducting in zero field, f(sub s), and the value of the upper critical field, (H sub c2) sub T=0. DOE

N88-12389# Los Alamos National Lab., N. Mex.
NEW THEORY FOR COMPETING INTERACTIONS AND MICRO-STRUCTURES IN PARTIALLY-ORDERED (LIQUID-CRYSTALLINE) PHASES
F. Dowell 1987 8 p Presented at the Workshop on Competing Interactions and Microstructures: Statics and Dynamics, Los Alamos, N. Mex., 5 May 1987
(Contract W-7405-eng-36)
(DE87-014739; LA-UR-87-2618; CONF-8705168-4) Avail: NTIS HC A02/MF A01

A summary of results from a unique statistical-physics theory to predict and explain competing interactions and resulting microstructures in some partially-ordered (in this case, liquid-crystalline (LC)) phases is presented. The static aspects of both partial orientational and partial positional ordering of the molecules into various microstructures in these phases (including the incommensurate smectic-Ad phase) can be understood in terms of various competing interactions (both entropic and energetic) involved in the packing together of the different molecular sub-units at given pressures and temperatures. These microstructures are predicted and explained (using no ad hoc or arbitrarily adjustable parameter) as a function of molecule chemical structure (including lengths and shapes (from bond lengths and angles), intramolecular rotations, site-site polarizabilities and pair potentials, dipole moments, etc). Theoretical results are presented for the nematic, re-entrant nematic, smectic-Ad, and smectic-Al LC phases and the isotropic phase. DOE

N88-12390# Los Alamos National Lab., N. Mex. Theoretical Div.
SIMULATION OF THE LAYER-GROWTH DYNAMICS IN SILVER FILMS: DYNAMICS OF ADATOM CLUSTERS AND VACANCY CLUSTERS ON Ag(100)
Arthur F. Voter 1987 14 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 20-21 Aug. 1987
(Contract W-7405-eng-36)
(DE87-014764; LA-UR-87-2807; CONF-8708110-11) Avail: NTIS HC A03/MF A01

Simulation results are presented for some dynamical processes occurring in the growth of (100) layers of silver. The overlayer dynamics are evolved using a recently developed method that, in the regime where surface diffusion consists of discrete hops, yields classically exact dynamics for an arbitrary interatomic potential. The time-scale limitations of direct molecular dynamics simulations are thus overcome. The Ag/Ag(100) system is modeled using a sophisticated form of interaction potential, similar to the embedded atom method, in which the energy is given by a sum of pairwise interactions plus a term for each atom that depends on the local atomic density. This type of potential includes the many-body terms necessary to describe a variety of atomic environments, such as the perfect fcc metal, free surfaces, vacancies, interstitials, and even the diatomic molecule, but with the computational scaling of a simple pair potential. The present study focuses on some of the dynamics in a single layer of silver: the diffusion and dissociation of clusters of adatoms and vacancies. Some interesting features are observed, including a non monotonic decrease in diffusion constant with increasing cluster size, and a roughly constant mean square distance a cluster migrates before dissociation (ejection of a monomer). DOE

N88-12391# Oak Ridge National Lab., Tenn. Solid State Div.
THE ITINERANT RESONATING-VALENCE-BOND MODEL FOR SUPERCONDUCTIVITY
S. H. Liu Aug. 1987 27 p Presented at the Symposium on Low Temperature Physics, Hsin-chu, Taiwan, 7 Sep. 1987
(Contract DE-AC05-84OR-21400)
(DE87-014794; CONF-8709124-1-Draft) Avail: NTIS HC A03/MF A01

It has been proposed that the pairing interaction in high temperature superconductors La(sub 2-x) Sr(sub x) CuO4 and Yba2Cu2O(sub 7-x) is magnetic in origin, and the recent discovery of antiferromagnetic ordering in La2CuO4 has been regarded as strong evidence in support of this so-called resonating-valence-bond (RVB) model. Close examination of the ordered state of this material reveals that it is an itinerant antiferromagnet. Accordingly, the superconducting properties must also be studied using the itinerant model approach, rather than the local moment model discussed so far in literature. This paper reports an approximate solution of the itinerant RVB model of superconductivity. It is shown that superconductivity can take place in a narrow region of the parameter space, and that the fluctuating local exchange field causes the superconducting state to be gapless. DOE

N88-12392# Siemens A.G., Erlangen (West Germany). Forschungslab.
POWDER-METALLURGICAL PREPARATION OF A15 SUPERCONDUCTORS Final Report, Jun. 1985
Manfred Wilhelm, Karl Wohlleben, Engelbert Springer, Klaus Mrowiec, Wilfried Schaper, and Joachim Wecker Aug. 1985 128 p In GERMAN; ENGLISH summary
(Contract BMFT-13-N-5294-6)
(ETN-87-90584) Avail: NTIS HC A07/MF A01

The powder-metallurgical preparation of Cu-N63Sn microcomposite superconductors was investigated in order to economize in the manufacture of the conductors and to improve

their mechanical and electrical properties. Conditions during high temperature extrusion are optimized by adding Al or Ti as reducing agents, also with a view to the following cold forming. Current densities well above 10,000 A/sq cm at 15T are obtained by applying coarse-grained Nb powder and incorporating small quantities of Ta or Ti. The current carrying behavior of the conductors was determined as a function of the degree of mechanical deformation, the cold forming technique, and the heat treatment conditions. Wires containing an internal tin source as well as bundled assemblies for high current applications were manufactured. Long wires can be produced. ESA

N88-12393# Kiel Univ. (West Germany). Mathematisch-Naturwissenschaftlichen Fakultaet.

INVESTIGATIONS OF CRYSTALLIZATION VELOCITY AND BORON DIFFUSION IN GLASSY IRON-BORON ALLOYS AND OF ACTIVITY COEFFICIENTS OF BORON IN CRYSTALLINE IRON-BORON ALLOYS Ph.D. Thesis [UNTERSUCHUNGEN DER KRISTALLISATIONSGESCHWINDIGKEIT UND DER BOR-DIFFUSION AN GLASARTIGEN EISEN-BOR-LEGIERUNGEN UND DER AKTIVITAETSKOEFFIZIENTEN DES BORS IN KRISTALLINEN EISEN-BOR-LEGIERUNGEN]

Juergen Maaz 1986 263 p In GERMAN Sponsored by Deutschen Forschungsgeimschaft

(ETN-87-90613) Avail: Issuing Activity

Thermodynamic and diffusion measurements were performed on crystalline binary Fe-B alloys, and recrystallization studies were made on metallic Fe-B and Fe-Ni-B glasses. The dependence of the recrystallization temperature on the heating rate was determined. The activation energies of the recrystallization are shown to vary between 160 and 280 kJ/mol. The melting temperatures were determined by differential thermoanalysis. The activation energies of the diffusion in the metallic glasses are between 70 and 130 kJ/mol. The diffusion coefficient depends only very slightly on the Fe-Ni composition. The limits of the solid solution is shifted towards substantially higher concentrations than found in the literature. The peritectoide decay temperature is 1188 K. Boron activities are strongly reduced in the alfa and gamma phase. ESA

N88-12394# Texas Univ., Austin. Dept. of Chemistry.

VECTORIAL ELECTRON TRANSFER ON DESIGNED SURFACES Annual Report, Feb. 1986 - Jan. 1987

A. J. Bard, A. Campion, M. A. Fox, T. E. Mallouk, and S. E. Webber 1987 114 p

(Contract GRI-5082-260-0756)

(PB87-232229; GRI-87/0151) Avail: NTIS HC A06/MF A01 CSCL 20L

Bipolar CdSe/CoS semiconductor photoelectrode panels, capable of vectorial electron transfer, were used in series arrays to photodecompose water to yield hydrogen and oxygen in stoichiometric ratio with a maximum solar efficiency of about 1 precent. An analytical model was developed for these arrays which addresses the question of watersplitting and electrical power generation efficiencies as functions of the number of panels, the overpotential of the gas generating electrodes, incident light intensity, and the concentrations of the redox couples. Hydrogen production using a self-assembling zeolite system was discovered. Sensitized anatase TiO2 electrodes were used in photoelectrochemical cells employing variety of solution redox couples. The photoassisted production of hydrogen from methanol-water solutions containing mixtures of small particles of CdS/SiO2 and a wide bandgap semiconductor (TiO, ZnO, SnO2, or WO3), supported on silica and platinized was studied. The phenomenon of interparticle charge separation for Cds/SiO2 was found to be operative for CdS/SiO2 with WS sub 2/SiO2. GRA

N88-12395# National Bureau of Standards, Boulder, Colo. Fracture and Deformation Div.

MATERIALS STUDIES FOR MAGNETIC FUSION ENERGY APPLICATIONS AT LOW TEMPERATURES-X

R. P. Reed May 1987 418 p Sponsored by DOE, Washington, D.C.

(PB87-232575; NBSIR-87/3067) Avail: NTIS HC A18/MF A01 CSCL 20L

The results of a research program to determine the properties of materials that may be used in cryogenic structures for the superconducting magnets of magnetic fusion energy power plants and prototypes. Its purpose is to facilitate their design and development. The program was developed jointly by the staffs of the National Bureau of Standards and the Office of Fusion Energy of the Department of Energy; is is managed by NBS and sponsored by DOE. Research is conducted at NBS and at other laboratories through subcontracts with NBS. Research results for 1986 are presented in technical papers under five headings that reflect the main program area: structural alloys, welding, nonmetallics, technology transfer, and United States-Japanese Cooperative Program. Objective and research highlights are summarized in the introduction to each program area.. GRA

N88-12396# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

ELIMINATION OF SUBBOUNDARIES IN 0.5-MICRON-THICK SI-ON-INSULATION FILMS PRODUCED BY ZMR

Michael W. Geis, Chenson K. Chen, and Henry I. Smith 1987 5 p Submitted for publication Sponsored in part by DARPA

(Contract F19628-85-C-0002)

(AD-A184590; MS-7524; ESD-TR-87-070) Avail: NTIS HC A02/MF A01 CSCL 09A

When Si-on-insulator films 0.3 to 0.5 microns thick are recrystallized by zone melting under the usual conditions, the defect trails within grains are subboundaries. The use of an entrainment pattern, consisting of a grating of carbonized photoresist on top of the the SiO2 encapsulating layer, can lead to the replacement of subboundaries by defect trails that are spaced dislocation clusters or discrete threading dislocations. Such defects are expected to be less detrimental to submicrometer MOSFET circuits than subboundaries. GRA

N88-12397# Nebraska Univ., Lincoln.

IMPROPER FERROELECTRICITY: A THEORETICAL AND EXPERIMENTAL STUDY Final Report No. 2, 1 Jun. 1983 - 31 May 1987

J. R. Hardy and F. G. Ullman 31 Jul. 1987 23 p

(Contract DAAG29-83-K-0080)

(AD-A184614; ARO-19393.7-PH) Avail: NTIS HC A03/MF A01 CSCL 20C

The theoretical and experimental investigations proposed for this period have been completed. First-principle theoretical lattice-dynamics calculations on the high and low-temperature commensurate phases of Rb2ZnC14, K2ZnC14, and BaMnF4 have indicated the origin of the incommensurate behavior in the intermediate phase. Molecular dynamics (M-D) calculations were developed that demonstrate how the orientational disorder develops in the molecular anion sublattice and how it relates to the incommensurate and commensurate phase transitions. These M-D calculations have also demonstrated the importance of including ionic polarization in these calculations. A general theory, based on latent symmetry, of incommensurate behavior in these, and probably many similar materials, has been developed and submitted for publication. Raman spectra have been obtained for various phases of these materials. An analytical method was developed for deconvoluting these severely overlapped spectra so that a one-to-one comparison with the theoretically-predicted lines could be made. GRA

N88-12398# Micrel, Inc., Sunnyvale, Calif.

DRAMATICALLY IMPROVED RADIATION HARDNESS FOR CMOS SILICON GATE INTEGRATED CIRCUITS EVEN DOWN TO CRYOGENIC TEMPERATURES Final Report

Martin Alter 29 Jun. 1987 3 p

(Contract N00014-86-C-0436)

(AD-A184672) Avail: NTIS HC A02/MF A01 CSCL 19F

This program focuses on Field-Hardness; specifically, the parasitic N-channel leakages which can result on the edge of an

N-Channel transistor from source to drain, from drain of one device to the drain of another or from drain (across the CMOS P-well) to the N-substrate (Vdd). This type of leakage normally causes device failure well before the more publicized gage-oxide problem cause it to drift out of spec. By butting a poly field-plate directly next to the device in the width direction (for example) we dramatically minimize the positive charge which can build up during irradiation since there is a minimal amount of oxide under this field plate; this technique is used to extend previously used concepts of using buried P+ guard-rings and special gate/field overlap layout to improve the Radiation Hardness of Integrated Circuits and has the added bonus of obviously not being sensitive to Carrier Freeze-out phenomena which degrades P+ guard-ring usefulness at a cryogenic temperatures. GRA

N88-12399# Clemson Univ., S.C. Dept. of Electrical Engineering.
EPITAXIAL REACTOR DEVELOPMENT FOR GROWTH OF SILICON-ON-INSULATOR DEVICES Final Report, Dec. 1984 - Jun. 1986
David J. Dumin Apr. 1987 90 p
(Contract F19628-85-K-0013)
(AD-A184758; RADC-TR-87-32) Avail: NTIS HC A05/MF A01 CSCL 20B

A hydride vapor phase epitaxy system was designed and constructed for testing boron phosphide as the insulator for a silicon-on-insulator material study. Layer structures grown were tested for electrical properties and thickness. Silicon deposited on the boron phosphide was of good quality, but not as good as bulk silicon. There was some diffusion of boron and phosphorus into the silicon. GRA

N88-12400# Stanford Univ., Calif.
PHASE EQUILIBRIUM AND CRYSTAL GROWTH STUDIES ON AgGaSe2 AND RELATED NONLINEAR OPTICAL MATERIALS Progress Report, 1 Jan. - 30 Jun. 1987
R. S. Feigelson 30 Jun. 1987 4 p
(Contract N00014-86-K-0343)
(AD-A184768) Avail: NTIS HC A02/MF A01 CSCL 20B

The main objective of this program is to gain an in-depth understanding of the thermodynamics, solid-state kinetics, and growth properties in the Ag-Ga-Se system so that we can reproducibly grow high optical quality crystals of AgGaSe2. This program began at Stanford on August 20, 1986. During the first four-month reporting period, emphasis was devoted to three areas: growth of 37 mm diameter crystals, increasing our growth capacity so that we can carry out more than one experiment at a time, and studies on the effects of heat treatment parameters on residual scattering centers and residual optical absorption. GRA

N88-12401# Sandia National Labs., Albuquerque, N. Mex.
INTERATOMIC AUGER RATES FOR THE SODIUM FLUORIDE CRYSTAL
T. A. Green and D. R. Jennison 1987 3 p Presented at the 3rd International Workshop on Desorption Induced by Electronic Transitions, Shelter Island, N.Y., 20 May 1987
(Contract DE-AC04-76DP-00789)
(DE87-013012; SAND-87-1832C; CONF-8705194-2) Avail: NTIS HC A02/MF A01

Interatomic Auger rates for the NaF crystal are calculated for initial 1s, 2s, and 2p holes in the Na2 ion. The crystal is simulated by an (NaF6) sup 5(-) cluster embedded in a large number of point ions, and the one-electron orbitals are obtained from restricted Hartree-Fock calculations of the initial state. The calculated interatomic Auger widths for the transitions Na(1s)Na(2p)F(2p), Na(2s)Na(2p)F(2p), and Na(2p)F(2p)F(2p)-prime are 0.00173, 0.641, and 0.153 eV, respectively. For comparison, the width of the Na(KLL) Auger transition is close to 0.26 eV. Widths for the transitions Na(1s)Na(2p)F(2p) and Na(2p)F(2p)F(2p)-prime can be inferred from experimental data. Theory and experiment agree to within 50%. This represents a considerable improvement over previous theoretical treatments. DOE

N88-12402# Sandia National Labs., Albuquerque, N. Mex.
CRYSTALLINE CELL RESEARCH STATUS AND DIRECTION
D. E. Arvizu 17 Sep. 1987 14 p Presented at the 3rd International Photovoltaic Science and Engineering Conference, Tokyo, Japan, 3 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE87-014214; SAND-87-2135C; CONF-871112-1) Avail: NTIS HC A02/MF A01

Summarized is the status of crystalline cell research in the program managed by Sandia National Laboratories and sponsored by the US Department of Energy (DOE). Recent advances in high efficiency and program direction are discussed for each of the three program elements which include one-sum crystalline silicon, concentrator silicon, and concentrator III-V material cells. DOE

N88-12403# California Univ., Berkeley. Lawrence Berkeley Lab.
MODELING OF PROXIMITY COUPLING BETWEEN SUPERCONDUCTING FILAMENTS IN SUPERCONDUCTING DIPOLE MAGNETS
M. A. Green Jun. 1987 10 p Presented at the Conference on Advances in Cryogenic Engineering, St. Charles, Ill., 14 Jun. 1987
(Contract DE-AC03-76SF-00098)
(DE87-014684; LBL-23823; CONF-8706125-12) Avail: NTIS HC A02/MF A01

There is a strong experimental evidence for superconducting current coupling between filaments in fine filament multifilamentary Nb-Ti which has been proposed for the SSC. The coupling between the fine filaments appears to be a Type II superconducting coupling. As a result, ac loss and magnetization can increase as one reduces the filament size in a fine filamentary conductor. This paper presents a computer model which fits experimental data for proximity superconducting coupling between filaments in a superconductor matrix. Using this model, one can predict the effect of proximity coupling on the field uniformity of a dipole magnet for the SSC. DOE

N88-12404# Oakland Univ., Rochester, Mich. Dept. of Chemistry.
A STRATEGY TO DETERMINE THE TRANSITION STATE OF AN ELECTRON TRANSFER REACTION
P. P. Schmidt and Lesser Blum 5 Aug. 1987 20 p
(Contract N00014-77-C-0239)
(AD-A183976; TR-27) Avail: NTIS HC A02/MF A01 CSCL 20E

The electron involved in an electron transfer reaction are represented as a wavepacket expanded in a limited basis set of appropriate functions. Saddle point optimization to determine the transition state involves moving the center of gravity of the wavepacket together with the atoms of the molecular framework. GRA

N88-12405# Pennsylvania Univ., Philadelphia. Dept. of Physics.
SUPERCONDUCTIVITY AS A SYNCHRONOUS SPATIAL ALTERNATION OF VALENCE BONDS
Richard P. Messmer Apr. 1987 13 p
(Contract N00014-86-K-0304)
(AD-A184208; TR-6) Avail: NTIS HC A03/MF A01 CSCL 07B

A new theoretical model for superconductivity is proposed which depends on a pairing in real space (valence bonds). Pair-pair correlations establish an ordered array of such pairs and a synchronous alternation among equivalent coherent spatial arrays of valence bonds is considered as the origin of superconductivity. Simple metals with two valence electrons (e.g., Be, Zn, etc.) are used to illustrate the ideas. The new high Tc materials (based on substitutions in La2CuO4) will be considered elsewhere. GRA

N88-12406# Westinghouse Research and Development Center, Pittsburgh, Pa.
INVESTIGATION OF HEXAGONAL FERRITE FILM GROWTH TECHNIQUES FOR MILLIMETER-WAVE SYSTEMS APPLICATIONS Final Report, Jun. 1985 - Jan. 1987
William E. Kramer, Kee-Chang Yoo, Zoltan Kun, Richard H. Hopkins, and Michael Daniel 15 Mar. 1987 119 p
(Contract DAAG29-84-C-0012)
(AD-A184335; Rept-87-9F4-HEXAF-R1; ARO-21187.3-EL) Avail: NTIS HC A06/MF A01 CSCL 20B

A number of new substrate and solvent solution systems for epitaxial ferrite growth was examined. The growth of single crystals of two new materials, cobalt gallate and Ta-substituted barium vanadate, was successfully demonstrated. Compositions lattice-matched to the ferrites were demonstrated, and ferrite films were grown on cobalt gallate. Interdiffusion of barium hexaferrite and barium vanadate prevented high-quality hexaferrite film growth on the latter substrate. GRA

N88-12407# Eltron Research, Inc., Aurora, Ill.
METAL INTERCALATION CHARACTERISTICS OF n-HfS2 PHOTOELECTRODES IN NON-AQUEOUS ELECTROLYTES Technical Report No. 1, Oct. 1986 - May 1987
Krystyna W. Semkow, Nirupama U. Pujare, and Anthony F. Sammells Jul. 1987 4 p Presented at the Electrochemical Society Meeting, Philadelphia, Pa., May 1987
(Contract N00014-86-C-0128)
(AD-A184381) Avail: NTIS HC A02/MF A01 CSCL 07D

The photoelectrochemical (PEC) performance of single crystal n-Hafniumdisulfide was correlated with capacitance and impedance measurements obtained with the photoanode van der Waals layers oriented either parallel or perpendicular to acetonitrile-based non-aqueous electrolytes, with and without copper chloride introduced as an intercalating redox species. For van der Waals layers perpendicular to the electrolyte (i.e., available for copper intercalation) space charge capacitance values of respectively .01 and 1 micro Farad/sq. cm were obtained for the non-intercalated and copper intercalated photoelectrodes. The implications of these experimental observations were discussed in relation to the application of these intercalating photoelectrodes in both liquid non-aqueous and solid polymer electrolyte PEC storage devices. GRA

N88-11792# Joint Publications Research Service, Arlington, Va.
SUPERCONDUCTIVITY OF PSEUDOBINARY COMPOUNDS A15 (V-Cr)3Si, (V-MO)3Si, Mo3(Si-Re), BOMBARDED WITH FAST NEUTRONS Abstract Only
A. Ye. Karkin, V. Ye. Arkhipov, A. V. Mirmelshteyn, V. I. Voronin, A. K. Shtolts, and B. N. Goshchitskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 4 Transl. into ENGLISH from Fizika Metallov i Metallovedeniye (Sverdlovsk, USSR), v. 62, Iss. 2, Aug. 1986 p 291-297 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

N88-11796# Joint Publications Research Service, Arlington, Va.
PRODUCTION OF METALLIC MONOCRYSTALS DESCRIBED
A. I. Manokhin *In its* JPRS Report: Science and Technology. USSR: Materials Science 6 Jul. 1987 p 40-49 Transl. into ENGLISH from Khimiya I Zhizn (Moscow, USSR), no. 5, May 1986 p 2-7 (For primary document see N88-11791 03-26)
Avail: NTIS HC A05/MF A01

N88-11869*# Alabama Univ., Huntsville.
HIGH TEMPERATURE SUPERCONDUCTORS
Maw-Kuen Wu *In its* Consortium for Materials Development in Space. Technical Section Sep. 1987 p 78-82 (For primary document see N88-11859 03-29)
Avail: NTIS HC A06/MF A01 CSCL 20L

N88-11894# Joint Publications Research Service, Arlington, Va.
LARGE-APERTURE HIGH-EFFICIENCY FREQUENCY DOUBLING USING TANDEM KDP CRYSTALS
Xijie Cai, Meilan Dai, Jiajun Lang, Ruixi Lu, and Wenhua Qin *In its* JPRS Report: Science and Technology. China 10 Jun. 1987 p 32-41 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 6, no. 12, Dec. 1986 p 1098-1104 (For primary document see N88-11888 03-31)
Avail: NTIS HC A06/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-12408# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
NEW NOTIONS ABOUT SPACE-TIME AND GRAVITATION
A. A. Logunov 1986 12 p In RUSSIAN
(DE87-703259; IFVE-OTF-86-138) Avail: NTIS (US Sales Only) HC A03/MF A01

Critical analysis of the general theory of relativity (GTR) is briefly described. Acceptance of its concept leads to the neglect of a series of fundamentally basic physical laws. Firstly, it ignores the conservation laws of energy-momentum and angular momentum of matter and gravitation. Secondly, it rejects the representation of the gravitational field as a classical one of the Faraday-Maxwell type including the density of energy-momentum. DOE

N88-12409# Lawrence Livermore National Lab., Calif.
PHASE TRANSITION OF MULTIFRACTALS
M. Duong-van Aug. 1987 9 p Presented at the International Workshop on Nonlinear Phenomena Chaos in Education, Balaton, Hungary, 26 Apr. 1987
(Contract W-7405-eng-48)
(DE87-014344; UCRL-96561-Rev-1; CONF-8704203-1-Rev-1; CONF-870159-4-Rev-1) Avail: NTIS HC A02/MF A01

The nature of phase transition of the Logistic Map is studied. Using the Ising model as an analogy, the set variables are identified with the thermodynamic variables and the specific heat of this set identified. The calculated specific heat varies logarithmically with the lattice size, in agreement with the lattice calculation results of Ferdinand and Fisher. The finite height and width of the specific heat of the set is shown to be a consequence of the finite lattice spacing. DOE

N88-11874# Joint Publications Research Service, Arlington, Va.
INTEGRATED 3-PARAMETER DIAGRAM FOR DETERMINING THERMODYNAMIC PROPERTIES OF FLUIDS
Guochang Zhao, Xiaoxue Deng, and Mingshan Zhu *In its* China report: Science and Technology 9 Apr. 1987 p 29-33 Transl. into ENGLISH from Ziran Zazhi (Shanghai, Peoples Republic of China), v. 9, no. 10, Oct. 1986 p 796-797 (For primary document see N88-11873 03-31)
Avail: NTIS HC A06/MF A01

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-12410# National Science Foundation, Washington, D.C.
NATIONAL SCIENCE FOUNDATION Annual Report, 1986
Jul. 1987 107 p
(PB87-228375; NSF-87-1) Avail: NTIS HC A06/MF A01; also available SOD HC $4.75 as 038-000-00576-6 CSCL 05A

The National Science Foundation (NSF) programs and activities for Fy 1986 are described. GRA

N88-12411# Administrative Sciences Corp., Alexandria, Va.
COMPETITION ANALYSIS MODEL (CAM). VOLUME 2: COMPUTER MANUAL Report, Sep. 1985 - Jun. 1987
12 Jun. 1987 35 p
(Contract F33615-85-C-5129)
(AD-A184017; ASC-R-162-Vol-2; BRMC-85-5129-2) Avail: NTIS HC A03/MF A01 CSCL 12A

The Competition Analysis Model, CAM, is designed to provide computational and analytical support to decisions on competition strategy and provide support throughout the life of a project. It is useful for decisions both early in the acquisition cycle and as a foundation for later detailed analyses at both the prime system level or for subsystems and components. CAM does not extrapolate from past experience, but outlines an approach to structuring competition based upon goals and relevant data. The Competition Analysis Model consists of three volumes (CAM Analysis Guide, CAM Computer Manual, and Program Maintenance Manual) and a disk containing the BASIC code for IBM-PC or PC compatible computers. This volume, CAM Computer Manual, is directed at the user who wishes to run the software and understand how the software can be used to do cost analysis of competition. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-12412*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
ADVANCED INFORMATION PROCESSING SYSTEM (AIPS) PROOF-OF-CONCEPT SYSTEM FUNCTIONAL REQUIREMENTS I/O NETWORK SYSTEM SERVICES
28 Feb. 1985 44 p
(Contract NAS9-16023)
(NASA-CR-181481; NAS 1.26:181481; CSDL-AIPS-84-138)
Avail: NTIS HC A03/MF A01 CSCL 05B

Requirements for input/output user communication; network control; status logging, collection, and reporting; test support; and functional interfaces are presented. B.G.

N88-12413*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
ADVANCED INFORMATION PROCESSING SYSTEM (AIPS) PROOF-OF-CONCEPT SYSTEM FUNCTIONAL DESIGN I/O NETWORK SYSTEM SERVICES
11 Mar. 1985 171 p
(Contract NAS9-16023)
(NASA-CR-181488; NAS 1.26:181488; CSDL-AIPS-84-139)
Avail: NTIS HC A08/MF A01 CSCL 05B

The function design of the Input/Output (I/O) services for the Advanced Information Processing System (AIPS) proof of concept system is described. The data flow diagrams, which show the functional processes in I/O services and the data that flows among them, are contained. A complete list of the data identified on the data flow diagrams and in the process descriptions are provided. B.G.

N88-12414# Department of Energy, Oak Ridge, Tenn.
ENERGY DATA BASE: SUBJECT THESAURUS
M. H. Raridon, ed. Sep. 1987 1027 p
(DE87-008007; DOE/TIC-7000-R7) Avail: NTIS HC A99/MF A01

This seventh edition of the subject thesaurus contains the standard vocabulary of indexing terms (descriptors) developed and structured by the technical staff of the Office of Scientific and Technical Information as part of its subject indexing activities for building and maintaining the Energy Data Base (EDB) and other energy information data bases for the Department of Energy (DOE). The purpose of this thesaurus is to enhance the efficiency of information retrieval from these data bases. This structured vocabulary reflects the scope of DOE's research, development, and technological programs and encompasses terminology derived not only from the basic sciences for also from areas of energy resources, conservation, safety, environmental impact, and regulation. There are 21,080 valid descriptors and 5683 forbidden terms in this edition of the Thesaurus. These descriptors are listed alphabetically. DOE

N88-12415# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Plant.
ELECTRONIC RECORDS ADMINISTRATION AT THE SAVANNAH RIVER PLANT
B. J. Hudson 1987 14 p Presented at the Department of Energy Automated Office Support System Conference, Denver, Colo., 7-8 Oct. 1987 Submitted for publication
(Contract DE-AC09-76SR-00001)
(DE87-014842; DP-MS-87-103; CONF-8710132-4) Avail: NTIS HC A03/MF A01

The Savannah River Plant (SRP), operated by DuPont for the Department of Energy (DOE), is faced with the problem of providing ready access to information. A sitewide information network has been installed implementing electronic mail (ALL-IN-1) and various other office automation features. However, users need access to information contained in manuals, earlier research reports, and technical publications located in the central files. Planning is under way to procure a document and information storage and retrieval system linked to the sitewide information network. The system should provide retrieval of image scans of any document via full text and keyword searching of current and archived documents. Old documents will be input to the system through a high-speed image scanning system and optical disk storage. Optical character recognition (OCR) will be performed on these images and the resulting text stored in a document search and retrieval system. A user will utilize the search system to identify the documents needed, and retrieve either the text only from the search system or the image scan from the optical storage system. DOE

N88-12416# Oak Ridge Gaseous Diffusion Plant, Tenn.
IDMS APPLICATION DOCUMENTATION MADE EASY
Russell L. Crisp, Johnnie M. Ratliff, and Pamela B. Thomas Apr. 1987 61 p
(Contract DE-AC05-84OR-21400)
(DE88-000199; K/CSD/INF-87/10) Avail: NTIS HC A04/MF A01

This report is written for the knowledgeable IDMS user to describe the methods and standards adopted by the EMIS section for the continuing documentation of the IDMS-based Engineering Management Information System. The methods and standards developed are based on the use of the Cullinet IDMS Integrated Data Dictionary (IDD) facility to maintain system documentation as an integral part of the system software. The documentation procedures described represent a relatively pain-free way to maintain system documentation and provide for complete, quality-assured documentation kept up-to-date as the application evolves. It also provides a readily available storehouse of system information which is useful for training new staff members, providing

information needed for system enhancements, and to provide users with technical consultation on system functions. DOE

N88-12417# Oak Ridge National Lab., Tenn.
THE IMPACT OF INFORMATION TECHNOLOGY ON RESEARCH IN SCIENCE AND ENGINEERING
Jonathan A. Morell 1987 29 p Presented at the Howard R. Davis Society for Knowledge Utilization, Pittsburgh, Pa., 9 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-000342; CONF-8710147-1) Avail: NTIS HC A03/MF A01

There is little research on the impact of information technology (IT) on how research is carried out by scientists and engineers. This paper draws on other bodies of writings which indirectly shed light on this question. Included are: the role of calculation in research, scientific productivity, the philosophical underpinnings of science and technology, systems analysis, and the use of computer aided design in engineering. A model is developed which helps identify the types of impact that IT may have on social system and epistemological aspects of research. Factors are hypothesized which may explain why IT may have particular effects in any given research endeavor. DOE

N88-12418# Naval Postgraduate School, Monterey, Calif.
CNET (CHIEF OF NAVAL EDUCATION AND TRAINING) PROGRAM AUTOMATED TRACKING SYSTEM (CPATS): A COMPREHENSIVE STUDY M.S. Thesis
Mary E. Williams Jun. 1987 58 p
(AD-A184694) Avail: NTIS HC A04/MF A01 CSCL 05A

The purpose of this thesis is to conduct a comprehensive analysis of the Chief of Naval Education and Training Program Automated Tracking System (CPATS) and its impact at the operational level. The methodology used involved reviews of the history, implementation and applications of the system and its benefits and costs in terms of information and funding. The results indicate that CPATS has the potential for improving the quality and the timeliness of important management information. Much of this potential has already been realized at CNET headquarters and in liaison with training sponsors. The full potential has not yet been realized at the field level, and recommendations toward that end are made herein. The study also indicated that the initial costs of implementing CPATS will be recovered with less than a full year's operating cost savings. Author (GRA)

N88-12419# Defense Technical Information Center, Alexandria, Va.
SOURCE HEADER LIST. VOLUME 2: L THROUGH Z Annual Report, Period Ending Jun. 1987
Sherry Hart Sep. 1987 615 p Supersedes DTIC/TR/86/14-Vol-2 DTIC/TR/86/14-Vol-2
(AD-A184001; DTIC/TR/87/14-Vol-2; DTIC/TR/86/14-VOL-2) Avail: NTIS HC A99/MF A01 CSCL 05B

This is the second of two volumes of an alphabetically arranged compilation of corporate author names used in the DTIC database system. For complete abstract, see V.1, AD-180000. GRA

N88-12420# Defense Technical Information Center, Alexandria, Va.
INFORMATION ANALYSIS CENTERS IN THE DEPARTMENT OF DEFENSE, REVISION
M. C. Rothschild Jul. 1987 160 p
(AD-A184002; DTIC/TR-87/17-Rev) Avail: NTIS HC A08/MF A01 CSCL 05B

The Department of Defense (DOD) Information Analysis Centers (IACs) have been assisting the research, development, and engineering efforts of the defense community for over forty years by analyzing, repackaging, and disseminating highly technical information in specialized subject areas to a select community. An overview of the IACs is presented, including an analysis of the IAC concept, followed by a brief history of the DOD IACs and an examination of some of the issues of concern to DOD IACs. IACs are not without their problems; nevertheless, they continue to have a significant role in the transfer of scientific and technical information. GRA

N88-12421*# Pennsylvania State Univ., University Park.
ADVANCED TECHNIQUES FOR THE STORAGE AND USE OF VERY LARGE, HETEROGENEOUS SPATIAL DATABASES. THE REPRESENTATION OF GEOGRAPHIC KNOWLEDGE: TOWARD A UNIVERSAL FRAMEWORK Interim Progress Report 2, 2 Apr. - 30 Jun. 1987
Donna J. Peuquet 15 Dec. 1987 66 p
(Grant NAG5-798)
(NASA-CR-181517; NAS 1.26:181517) Avail: NTIS HC A04/MF A01 CSCL 05B

A new approach to building geographic data models that is based on the fundamental characteristics of the data is presented. An overall theoretical framework for representing geographic data is proposed. An example of utilizing this framework in a Geographic Information System (GIS) context by combining artificial intelligence techniques with recent developments in spatial data processing techniques is given. Elements of data representation discussed include hierarchical structure, separation of locational and conceptual views, and the ability to store knowledge at variable levels of completeness and precision. Author

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-12422# Committee on Science and Technology (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1988
Washington GPO 1987 19 p H.R. 2782 enacted into law by the 100th Congress, 2d session, 30 Oct. 1987
(Pub-Law-100-147) Avail: US Capitol, House Document Room

Appropriations were authorized to the National Aeronautics and Space Administration for research and development; space flight, control, and data communications; constructions of facilities; and research and program management; and for other purposes. Author

N88-12423# Committee on Appropriations (U.S. Senate).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, AND CERTAIN INDEPENDENT AGENCIES APPROPRIATIONS, 1988, PART 2
Washington GPO 1987 392 p Hearings on H.R. 2783 before the Committee on Appropriations, 100th Congr., 1st Sess., 1-2 Apr., 9-10 Apr., and 24 Apr. 1987
(S-Hrg-100-106-Pt-2; GPO-76-151) Avail: Committee on Appropriations

Budget authority for the Department of Housing and Urban Development, the National Aeronautics and Space Administration, the Federal Home Loan Bank Board, the Neighborhood Reinvestment Corporation, and the National Institute of Building Sciences was discussed in these hearing. For individual titles, see N88-12424 through N88-12425.

N88-12424# Committee on Appropriations (U.S. Senate).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1988, THURSDAY, 9 APRIL 1987: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Department of Housing and Urban Development, and Certain Independent Agencies Appropriations, 1988, Part 2 1987 p 1019-1115 (For primary document see N88-12423 03-84)
Avail: Committee on Appropriations

Oral and written statements of the NASA Administrator before the subcommittee are presented, as well as written questions and responses to them. Areas of emphasis include plans for an orbital space station and heavy lift launch capability. J.P.B.

N88-12425# Committee on Appropriations (U.S. Senate).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1988, FRIDAY, 10 APRIL 1987: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Department of Housing and Urban Development, and Certain Independent Agencies Appropriations, 1988, Part 2 1987 p 1117-1197 (For primary document see N88-12423 03-84)
Avail: Committee on Appropriations

Oral and written testimony of the NASA Administrator before the subcommittee is presented. The emphasis is on plans for an orbital space station, heavy lift launch vehicles, the resumption of shuttle flights, the Hubble Space Telescope, and aircraft energy efficiency. Some attention is given to other NASA space exploration and new technology programs. J.P.B.

N88-12135# European Space Agency, Paris (France). Legal Affaires Div.
LEGAL PROTECTION OF THE POLAR PLATFORM'S USERS
A. Vahrenwald *In its* Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 27-34 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

N88-12136# Hunting Technical Services Ltd., Borehamwood (England).
CONFIDENTIALITY OF DATA
J. W. Trevett *In* ESA, Commercial Opportunities for Remote Sensing with Polar Platforms Apr. 1987 p 35-37 (For primary document see N88-12131 03-43)
Copyright Avail: NTIS HC A05/MF A01

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-12426*# National Aeronautics and Space Administration, Washington, D.C.
SPINOFF
James J. Haggerty Aug. 1986 131 p Original contains color illustrations
(NASA-TM-89651; NAS 1.15:89651) Avail: NTIS HC A07/MF A01; also available SOD HC $6.50 as 033-000-00989-5 CSCL 05B

The major programs that generate new technology and therefore expand the bank of knowledge available for future transfer are outlined. The focal point of this volume contains a representative sampling of spinoff products and processes that resulted from technology utilization, or secondary application. The various mechanisms NASA employs to stimulate technology utilization are described and in an appendix, are listed contact sources for further information. B.G.

N88-12427*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF FREE-PISTON STIRLING ENGINE TECHNOLOGY FOR SPACE POWER APPLICATION Final Report
Jack G. Slaby 1987 23 p Presented at the Solar Energy Conference, Honolulu, Hawaii, 22-27 Mar. 1987; sponsored by ASME, JSME and JSES
(Contract DE-AI05-82OR-1005)
(NASA-TM-88886; DOE/NASA/1005-12; E-3295; NAS 1.15:88886) Avail: NTIS HC A03/MF A01 CSCL 10B

An overview is presented of free-piston Stirling engine activities, directed toward space power applications. One of the major elements of the program is the development of advanced power conversion. Under this program the status of the 25 kWe opposed-piston Space Power Demonstrator Engine (SPDE) is presented. Initial differences between predicted and experimental power outputs and power output influenced by variations in regenerators are discussed. Technology work was conducted on heat-exchanger concepts to minimize the number of joints as well as to enhance the heat transfer in the heater. Design parameters and conceptual design features are also presented for a 25 kWe, single-cylinder free-piston Stirling space power converter. Projections are made for future space power requirements over the next few decades along with a recommendation to consider the use of dynamic power conversion systems, either solar or nuclear. A cursory comparison is presented showing the mass benefits of a Stirling system over a Brayton system for the same peak temperature and output power. A description of a study to investigate the feasibility of scaling a single-cylinder free-piston Stirling space power module to the 150 kWe power range is presented. Author

N88-12428*# Detroit Diesel Allison, Mich.
ADIABATIC DIESEL ENGINE COMPONENT DEVELOPMENT: REFERENCE ENGINE FOR ON-HIGHWAY APPLICATIONS Interim Report, 1 May 1985 - 30 Apr. 1986
Nabil S. Hakim Apr. 1986 470 p
(Contracts DEN3-329; DE-AI01-86CE-50162)
(NASA-CR-179531; DOE/NASA-0329-1; NAS 1.26:179531; DDA-R01-ADECD-NAS) Avail: NTIS HC A20/MF A01 CSCL 13F

The main objectives were to select an advanced low heat rejection diesel reference engine (ADRE) and to carry out systems analysis and design. The ADRE concept selection consisted of: (1) rated point performance optimization; (2) study of various exhaust energy recovery scenarios; (3) components, systems and engine configuration studies; and (4) life cycle cost estimates of the ADRE economic worth. The resulting ADRE design proposed a reciprocator with many advanced features for the 1995 technology demonstration time frame. These included ceramic air gap insulated hot section structural components, high temperature tribology treatments, nonmechanical (camless) valve actuation systems, and elimination of the cylinder head gasket. ADRE system analysis and design resulted in more definition of the engine systems. These systems include: (1) electro-hydraulic valve actuation, (2) electronic common rail injection system; (3) engine electronic control; (4) power transfer for accessory drives and exhaust energy recovery systems; and (5) truck installation. Tribology and performance assessments were also carried out. Finite element and probability of survival analyses were undertaken for the ceramic low heat rejection component. Author

N88-12158# Centre National d'Etudes Spatiales, Toulouse (France). Lab. d'Etudes et de Recherches en Teledetection Spatiale.
ADAPTATION OF NUMERICAL SPOT DATA TO AN URBAN ENVIRONMENT
Jacques Tournet, Jean Cussol, Catherine Pedron, Gilbert Saint, and Catherine Leprieur *In its* SPOT 1: First In-Flight Results 1987 p 121-126 In FRENCH; ENGLISH summary (For primary document see N88-12143 03-43)
Copyright Avail: CEPADUES-Editions, Toulouse, France

88 SPACE SCIENCES (GENERAL)

N88-12429*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW EARTH ORBIT ENVIRONMENTAL EFFECTS ON THE SPACE STATION PHOTOVOLTAIC POWER GENERATION SYSTEMS
Henry K. Nahra [1977] 20 p Proposed for presentation at the 1988 Solar Energy Conference, Golden, Colo., 10-14 Apr. 1988; sponsored by ASME
(NASA-TM-100230; E-3852; NAS 1.15:100230) Avail: NTIS HC A03/MF A01 CSCL 10A

A summary of the Low Earth Orbital Environment, its impact on the Photovoltaic Power systems of the space station and the solutions implemented to resolve the environmental concerns or issues are described. Low Earth Orbital Environment (LEO) presents several concerns to the Photovoltaic power systems of the space station. These concerns include atomic oxygen interaction with the polymeric substrate of the solar arrays, ionized environment effects on the array operating voltage, the effects of the meteoroids and debris impacts and penetration through the different layers of the solar cells and their circuits, and the high energy particle and radiation effects on the overall solar array performance. Potential solutions to some of the degrading environmental interactions that will provide the photovoltaic power system of the space station with the desired life are also summarized. Author

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-12430# Geneva Observatory (Switzerland).
THE PULSATION MODES OF CO AUR
J. Babel and G. Burki (Lausanne Univ., Switzerland) 1987 12 p Submitted for publication Sponsored by the Swiss National Science Foundation
(Publ-Ser-C-Fasc-10; ETN-87-91104) Avail: NTIS HC A03/MF A01

Photoelectric measurements in radial velocity and photometry of the peculiar double-mode Cepheid CO Aur, confirm the 2 periods P1 = 1d.78 and P2 = 1d.43. A mean radius of 43 +/- 13 solar radii is derived by applying the Baade-Wesselink method. It is suggested that CO Aur is radially pulsating in 2 overtone modes, probably 1 and 2. ESA

N88-12431 Florida Univ., Gainesville.
RIGOROUS COMPILATION OF THE NORTHERN INTERNATIONAL REFERENCE STARS (NIRS) Ph.D. Thesis
Carl Stephen Cole 1986 146 p
Avail: Univ. Microfilms Order No. DA8715985

The tabular method of determining the systematic differences between two star catalogues is discussed. It is noted that the tabular method is subjective in nature and that the estimation of the model parameters does not use all available model constraints. Furthermore, these estimates are not least squares estimates nor are they unbiased. The simultaneous estimation of both target parameters and model parameters is applied to the compilation of a complete star catalogue. By simultaneously using all available constraints on all available data, more precise estimates for the target parameters are obtained. The more input material of the Northern International Reference Stars (NIRS) is used and the resulting catalogue is compared to the NIRS catalogue compiled by Corbin in 1982 using standard techniques. It is shown that the new estimates of the star parameters have smaller formal errors than estimates derived from the same material but using conventional procedures. Both versions of the NIRS are used to predict the star positions of the later observed Perth 70: A Catalogue of Positions of 24900 Stars and these predicted positions are compared to the actual observed positions. Dissert. Abstr.

N88-11692# Joint Publications Research Service, Arlington, Va.
HARD X-RAY TELESCOPE HAPI-1 AND ITS OBSERVATION OF CRAB PULSAR Abstract Only
Changjiang Dai *In its* JPRS Report: Science and Technology. China 17 Jun. 1987 p 39 Transl. into ENGLISH from Tianti Wuli Xuebao (Beijing, Peoples Republic of China), v. 7, no. 2, Apr. 1987 p 140-146 (For primary document see N88-11688 03-13)
Avail: NTIS HC A06/MF A01

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N88-12432# Fermi National Accelerator Lab., Batavia, Ill.
PARTICLE PHYSICS AND COSMOLOGY
E. W. Kolb Oct. 1986 56 p Presented at the Theoretical Advanced Study Institute Conference, Santa Cruz, Calif., 23 Jun. 1986
(Contract DE-AC02-76CH-03000)
(DE87-005400; FNAL/C-86/146-A; CONF-8606259-3) Avail: NTIS HC A04

This series of lectures is about the role of particle physics in physical processes that occurred in the very early stages of the big bang. Of particular interest is the role of particle physics in determining the evolution of the early Universe, and the effect of particle physics on the present structure of the Universe. The use of the big bang as a laboratory for placing limits on new particle physics theories will also be discussed. Section 1 reviews the standard cosmology, including primordial nucleosynthesis. Section 2 reviews the decoupling of weakly interacting particles in the early Universe, and discusses neutrino cosmology and the resulting limits that may be placed on the mass and lifetime of massive neutrinos. Section 3 discusses the evolution of the vacuum through phase transitions in the early Universe and the formation of topological defects in the transitions. Section 4 covers recent work on the generation of the baryon asymmetry by baryon-number violating reactions in Grand Unified Theories, and mentions some recent work on baryon number violation effects at the electroweak transition. Section 5 is devoted to theories of cosmic inflation. Finally, Section 6 is a discussion of the role of extra spatial dimensions in the evolution of the early Universe. DOE

N88-12433# Lawrence Livermore National Lab., Calif.
ADIABATIC SUPERNOVA EXPANSION INTO THE CIRCUMSTELLAR MEDIUM
D. L. Band and E. P. Liang Jun. 1987 7 p Presented at the 101st International Astronomics Union Colloquium on interaction of Supernova Remnants with the Interstellar Medium, Penticton, British Columbia, 8 Jun. 1987
(Contract W-7405-eng-48)
(DE87-014241; UCRL-95525; CONF-8706201-1) Avail: NTIS HC A02/MF A01

We perform one dimensional numerical simulations with a Lagrangian hydrodynamics code of the adiabatic expansion of a supernova into the surrounding medium. The early expansion follows Chevalier's analytic self-similar solution until the reverse shock reaches the ejecta core. We follow the expansion as it evolves towards the adiabatic blast wave phase. Some memory of the earlier phases of expansion is retained in the interior even when the outer regions expand as a blast wave. We find the results are sensitive to the initial configuration of the ejecta and to the placement of gridpoints. DOE

N88-12434# Brookhaven National Lab., Upton, N. Y.
NEUTRINOS IN SUPERNOVAE
J. Cooperstein Oct. 1986 47 p Presented at the Hans Bethe's Birthday Conference on Supernovae, Ithaca, N.Y., 19 Oct. 1986
(Contract DE-AC02-76CH-00016)

(DE87-014295; BNL-40105; CONF-8610332-1) Avail: NTIS HC A03/MF A01

The role of neutrinos in Type II supernovae is discussed. An overall view of the neutrino luminosity as expected theoretically is presented. The different weak interactions involved are assessed from the standpoint of how they exchange energy, momentum, and lepton number. Particular attention is paid to entropy generation and the path to thermal and chemical equilibration, and to the phenomenon of trapping. Various methods used to calculate the neutrino flows are considered. These include trapping and leakage schemes, distribution-averaged transfer, and multi-energy group methods. The information obtained from the neutrinos caught from Supernova 1987 is briefly evaluated. DOE

N88-12435# Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics.

NUMBER COUNT-REDSHIFT RELATION IN UNIVERSE MODELS WITH NONZERO COSMOLOGICAL CONSTANT

Kenji Tomita Oct. 1986 12 p

(DE87-703043; RRK-86-43) Avail: NTIS (US Sales Only) HC A03/MF A01

The selection of universe models has so far been performed by comparing mainly the theoretical redshift - magnitude relation with observational data, but the evolutionary changes in the absolute luminosity of sources have made their unambiguous selection difficult. Recent photometric data on the number count of galaxies and their redshifts are very appropriate to their selection, because the evolution of galaxies have little influence on the number count - redshift relation. The analysis is extended in the case of the cosmological constant lambda = 0 to the case of lambda not = 0 and show whether the Lemaitre models can be consistent with their data or not. DOE

N88-12436# Geneva Observatory (Switzerland).

THE NUCLEUS OF LT-5: AN UNUSUAL TRIPLE SYSTEM?

G. Jasniewicz, A. Duquennoy, and A. Acker (Observatoire de Strasbourg, France) 1987 14 p Submitted for publication Sponsored by the Swiss Natural Science Foundation and CNRS (Publ-Ser-C-Fasc-11; ETN-87-91105) Avail: NTIS HC A03/MF A01

Radial velocities of the G5III star located at the center of the planetary nebula LT-5 were obtained with a radial velocity scanner. The existence of 2 blended correlation dips which behave as the 2 components of an SB2 seems to indicate the presence of a close binary, which may be a coalescing system approaching the FK Comae stage. A third body is invoked to explain the observed variations of the systemic velocity. The orbital period of the binary containing the G-star is 2 days. The other one related to the third body is not safely defined. The small orbital inclination of the inner orbit prevents the visibility of eclipses. The photometric variations discovered by Schnell and Purgathofer (1983) are confirmed, but the possible periods differ from the 2 day period found. This difference may be due to migrating starspots on the G-binary. ESA

N88-12437# Geneva Observatory (Switzerland).

GRIDS OF EVOLUTIONARY MODELS OF MASSIVE STARS WITH MASS LOSS AND OVERSHOOTING. PROPERTIES OF WOLF-RAYET STARS SENSITIVE TO OVERSHOOTING

A. Maeder and G. Meynet 1987 31 p Submitted for publication

(Publ-Ser-C-Fasc-12; ETN-87-91106) Avail: NTIS HC A03/MF A01

In order to establish a reference grid of massive star models, the evolution of stars of initial mass 120, 85, 60, 40, 25, 20, and 15 solar masses is followed from the 0 age sequence to the end of the C-burning phase. An overshooting parameter which reproduces at best the observed main sequence (MS) width as found by Mermilliod and Maeder (1986) for young clusters and associations is chosen. The overshooting, with the extent and the mass loss rates adopted, produces an MS narrowing for O-stars and a large MS widening for early B-type stars. When compared to other sets of models, the results allow the identification of observable properties sensitive to overshooting for a given mass loss. These are the mapping of surface C/N and O/N ratios for stars in the upper HR diagram, the mass limits for red supergiants and WR stars, and the slope of the mass-luminosity relation for WR stars. ESA

N88-12438 Pennsylvania State Univ., University Park.

COMPARISON OF GLOBAL AND NUCLEAR PROPERTIES OF STARBURST AND SEYFERT 1 GALAXIES Ph.D. Thesis

Christopher Linus Brungardt 1987 140 p

Avail: Univ. Microfilms Order No. DA8714792

A comparison of nuclear and host galaxy properties of starburst and Seyfert 1 galaxies is made. Red CCD imagery is combined with emission line spectroscopy to obtain nuclear and host galaxy R band absolute magnitudes and emission line widths. These are used to search for line width luminosity correlations, such as the Tully-Fisher relation, and to compare the host galaxies of the two types of galaxies. There is no correlation between nuclear luminosity and host galaxy luminosity for either starbursts or Seyferts. The average Seyfert nucleus is three times as luminous compared to the host galaxy as the average starburst nucleus. Starburst emission line width is well correlated with nuclear and host galaxy luminosity. The fundamental correlation appears to be with the nuclear luminosity, although the slope of host galaxy line width luminosity has the same slope. This means the total luminosity of a starburst galaxy can be predicted by measuring the emission line width. The line widths are less than the stellar velocity dispersion in Sc type galaxies, but are greater than disk rotational velocities. The slope of the correlation is incompatible with the Tully-Fisher or Faber-Jackson relations, and an extension of giant HII regions to the starburst luminosity regime. Dissert. Abstr.

N88-12439 Princeton Univ., N. J.

GRAVITATIONAL ACCRETION OF HOT DARK MATTER Ph.D. Thesis

York Henry Dobyns 1987 108 p

Avail: Univ. Microfilms Order No. DA8714904

The formation of a galactic halo through the accretion of hot dark matter around a pre-existing mass perturbation of unspecified nature is studied by means of a spherically symmetric N-body computer simulation with 125,000 particles. A full description of the simulation is given and tests of its consistency are discussed. An alternative approach to the problem, involving the integration of Liouville's equation for the system, is developed and used to find a theoretical condition for stable equilibrium which is compared to the model results. Dissert. Abstr.

N88-12440 Florida Univ., Gainesville.

KINEMATICS AND DYNAMICS OF BARRED SPIRAL GALAXIES Ph.D. Thesis

Martin Nicholas England 1986 324 p

Avail: Univ. Microfilms Order No. DA8715989

The kinematics and dynamics of a group of barred spiral galaxies are analyzed. Hydrodynamical models using the beam scheme are calculated and provide a set of dynamical properties for barred spiral galaxies. Neutral hydrogen radio observations of NGC 1300 show the galaxy to be an excellent example of a grand design spiral system. The HI gas is mostly confined to the spiral arms with very little interarm gas. The velocity field show that circular motion is the dominant component but that large non-circular motion, mainly in the arms, are present. Near infrared surface photometry is used to calculate a triaxial ellipsoidal figure for the bar. Blue and 2.2 micron photometry is analyzed and compared with the I band and 21 cm observations. Hydrodynamical models for NGC 1300 are partially successful in reproducing the observed morphology and kinematics of NGC 1300. Various combinations of parameters are investigated and a composite best model presented. This model consists of an n = 1 Toomre disk, a triaxial bar, an 1 = 2 oval distortion and a halo. The pattern speed of 19.3 km/sec/kpc places corotation just outside of the end of the bar. Dissert. Abstr.

N88-12441 Pennsylvania State Univ., University Park.
INVESTIGATIONS OF EXTRAGALACTIC HYDROXYL Ph.D. Thesis
Joan T. Schmelz 1987 204 p
Avail: Univ. Microfilms Order No. DA8714873

Observations of extragalactic hydroxyl (OH) probe the physical conditions of galactic nuclear regions. The four 18 cm spectral lines of OH are known to respond differently to various conditions, possible making hydroxyl a better probe than CO and HI in certain galaxies. The results are presented of an extensive survey for extragalactic hydroxyl using the Arecibo telescope. The OH is observed in absorption and in Megamaser emission but not in thermal emission despite low noise values. This survey was used as the basis for a statistical study between OH content and other parameters of the parent galaxy. Statistical methods for samples with upper limits were used to find correlations between pi sub OH and the Hubble Type, IRAS colors, infrared luminosity, and IR-to-blue luminosity ratio of the galaxy. Two galaxies were then studied in detail using the Very Large Array (VLA) interferometer. The first was NGC 3628, and edge-on spiral galaxy in the Leo Triplet. The second galaxy studied with the VLA was Mrk 273, a Seyfert with HI absorption and OH Megamaser emission. Results are presented. Dissert. Abstr.

N88-12442# Johns Hopkins Univ., Baltimore, Md. Center for Astrophysical Sciences.
KINEMATICS AND GALACTIC STRUCTURE
Allan Sandage Dec. 1986 21 p Presented at the Workshop on The Galaxy, Cambridge, United Kingdom, Aug. 1986 Submitted for publication
(Preprint-18) Avail: NTIS HC A03/MF A01

A radial velocity and photometric study of some 900 high proper motion stars in the solar neighborhood, recently completed at Mount Wilson, is combined with the earlier subdwarf literature to review the dependencies of kinematics on metallicity. The data confirm the conclusion that the oldest stars, with only a very few exceptions, are moving on highly eccentric orbits, and have higher W velocities than younger stars. The interpretation is again put forward for a collapse from a larger volume as the formation process of the Galaxy. Author

N88-12443# California Univ., Santa Barbara. Inst. for Theoretical Physics.
COSMOLOGY WITH DECAYING VACUUM ENERGY
K. Freese, F. Adams, J. Frieman, and E. Mottola Sep. 1987 10 p Presented at the 194th American Chemical Society National Meeting, New Orleans, La., 30 Aug. 1987 Prepared in cooperation with California Univ., Berkeley and Stanford Linear Accelerator Center, Menlo Park, Calif.
(Contract DE-AC03-76SF-00515)
(DE88-000698; SLAC-PUB-4409; CONF-870802-21) Avail: NTIS HC A02

Motivated by recent attempts to solve the cosmological constant problem, we examine the observational consequences of a vacuum energy density which decays in time. For all times later than t is approximately 1 sec, the ratio of the vacuum to the total energy density of the universe must be small. Although the vacuum cannot provide the missing mass required to close the universe today, its presence earlier in the history of the universe could have important consequences. We discuss restrictions on the vacuum energy arising from primordial nucleosynthesis, the microwave and gamma ray background spectra, and galaxy formation. A small vacuum component at the era of nucleosynthesis, 0.01 is less than rho(sub vac)/rho(sup rad) less than 0.1, and increases the number of allowed neutino species to N(sup nu) greater than 5, but in some cases would severely distort the microwave spectrum. DOE

N88-11730 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ENVIRONMENTAL INTERACTIONS OF SOLAR GENERATORS IN SPACE
K. Bogus *In* CNES, Space Environment Technology Apr. 1987 p 663-679 (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

1987 p 663-679 (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-12444# Hochschule der Bundeswehr, Munich (West Germany). Wissenschaftlicher Studiengang Vermessungswesen.
REMOTE SENSING OF PLANETS AND CARTOGRAPHIC RESULTS [FERNERKUNDUNG DER PLANETEN UND KARTOGRAPHISCHE ERGEBNISSE]
Gerhard Neukum and Gustav Neugebauer, ed. Dec. 1984 99 p In GERMAN; ENGLISH summary
(HSBW-Heft-14; ISSN-0173-1009; ETN-87-90583) Avail: NTIS HC A05/MF A01

The current appearance and past geological evolution of the Moon, Mercury, Venus, Mars, and the satellites of Jupiter and Saturn are reviewed based on remote sensing measurements, primarily images taken by cameras during planetary exploration. Examples of planetary imagery, and of topographic and thematic maps are given, with emphasis on Mars and the moons of Jupiter and Saturn. The present status of the American planetary cartography program is discussed in the context of its application to planetological research. The system of orientation of the planetary objects for astronomical and cartographic purposes is described. Examples of multispectral images show that difference in surface material composition can be visualized. ESA

N88-12445# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
DESIGN STUDY FOR ASTEROIDAL EXPLOITATION
Carl Adams, Jim Blissit, Dave Jarrett, Rob Sanner, and Koji Yanagawa 15 Aug. 1985 240 p
Avail: NTIS HC A11/MF A01

A systematic approach to asteroidal exploitation for the 1990 to 2010 time frame is presented as an initial step toward expanding the use of space beyond the space station by providing a source of lower cost materials. With only a limited amount of information known about the asteroids, reconnaissance and exploration phases to determine the exact locations and compositions of several earth-approaching asteroids are required. Earth-based telescopes are used to locate and study the asteroids, while unmanned probes will return samples of asteroidal material to earth for analysis. After these phases are completed, the retrieval of a 35,000 metric ton piece of the asteroid Anteros is undertaken. A cargo transporter uses magnetoplasmadynamic (MPD) arcjets outbound and a mass-driver using asteroidal material inbound. A crew ship uses ion engines. Low thrust trajectories are used for both spacecraft. A materials processing facility will manufacture propellant pellets and retrieve non-propellant materials for spacecraft use. The cost is 1/10th that to transport the same materials from earth to high earth orbit. The project will cost 25 percent less if done in conjunction with a lunar and Martian base. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N88-12446* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LYMAN ALPHA SMM/UVSP ABSOLUTE CALIBRATION AND GEOCORONAL CORRECTION
Juan M. Fontenla and Edwin J. Reichmann Oct. 1987 20 p
(NASA-TM-100314; NAS 1.15:100314) Avail: NTIS HC A03/MF A01 CSCL 03B

Lyman alpha observations from the Ultraviolet Spectrometer Polarimeter (UVSP) instrument of the Solar Maximum Mission (SMM) spacecraft were analyzed and provide instrumental calibration details. Specific values of the instrument quantum efficiency, Lyman alpha absolute intensity, and correction for geocoronal absorption are presented. Author

N88-12447*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
CORONAL MAGNETIC FIELDS PRODUCED BY PHOTOSPHERIC SHEAR
P. A. Sturrock and W.-H. Yang (Utah State Univ., Logan.) Oct. 1987 23 p
(Grant NGL-05-020-272)
(NASA-CR-181514; NAS 1.26;181514; CSSA-ASTRO-87-17)
Avail: NTIS HC A03/MF A01 CSCL 03B

The magneto-frictional method is used for computing force free fields to examine the evolution of the magnetic field of a line dipole, when there is relative shearing motion between the two polarities. It found that the energy of the sheared field can be arbitrarily large compared with the potential field. It is also found that it is possible to fit the magnetic energy, as a function of shear, by a simple functional form. Author

N88-12448*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
THE IMPACT OF VARVES ON SOLAR PHYSICS
R. N. Bracewell May 1987 9 p
(Grant NGL-05-020-272)
(NASA-CR-181519; NAS 1.26:181519; AD-A184257; CSSA-ASTRO-87-9) Avail: NTIS HC A02/MF A01 CSCL 03B

The discovery of 680-million year old varves recording several millennia of fossil solar cycles, is a most exciting development that is bound to make an impact on solar physics. Already new problems of physical understanding have been posed by the 315-year Elatina cycle and the separate 350-year cycle, or undulation. The Elatina cycle evidences itself multiplicatively in the form of amplitude modulation with a distinctive nonsinusoidal envelope, while the undulation component is additive and quasisinusoidal. Both of these periodic phenomena are present in historical records of sunspots, but would not have been discerned from modern solar observations, which do not date back far enough. The explanation of two such sharply defined periods, in addition to the less sharply defined 22-year magnetic cycle, will require an understanding of solar physics that we do not yet have. Examples of the impact that the varve discovery is beginning to make are given, and a previously proposed mechanism for driving the activity cycle is extended in terms of a magnetic wave propagated radially outward from a deep torsional oscillator. GRA

N88-12449# California Univ., Los Angeles. Dept. of Astronomy.
SOLAR MAGNETIC AND VELOCITY FIELDS Annual Report, 16 Dec. 1985 - 30 Jun. 1987
Roger K. Ulrich 30 Jun. 1987 14 p
(Contract N00014-86-K-0056)
(AD-A184360) Avail: NTIS HC A03/MF A01 CSCL 03B

Fast-Scan Program; Magnetic and Velocity Maps; Limb Shift; and Differential Rotation with Altitude are discussed in this report on solar magnetic and velocity fields. GRA

N88-11704 Observatoire du Pic-du-Midi, Bagneres de Bigorre (France).
THE SUN AND THE SOLAR ACTIVITY
J. L. Leroy *In* CNES, Space Environment Technology Apr. 1987 p 53-63 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11705 Observatoire de Paris-Meudon (France). Dept. de Recherche Spatiale.
THE SOLAR WIND
Jean-Louis Steinberg *In* CNES, Space Environment Technology Apr. 1987 p 65-71 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N88-12450# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 514, JUNE 1987. PART 2: (COMPREHENSIVE REPORTS). DATA FOR DECEMBER 1986
Helen E. Coffey, ed. and John A. McKinnon, ed. Jun. 1987 33 p
(Contract N00014-86-F-0049)
(PB87-217279; SGD-514-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A03/MF A01 CSCL 03B

Solar-geophysical data contained include: detailed index for 1986 to 1987; data for December 1986 (Meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar X-ray radiation from GOES satellite graphs, mass ejections from the Sun, active prominences and filaments); and miscellaneous data (Chinese solar-geophysical data, explanation of data reports). GRA

N88-12451 Cornell Univ., Ithaca, N.Y.
X-RAY PULSARS: ACCRETION FLOW DECELERATION Ph.D. Thesis
Guy Scott Miller 1987 151 p
Avail: Univ. Microfilms Order No. DA8708911

X-ray pulsars are thought to be neutron stars which derive the energy for their X-ray emission by accreting material onto their magnetic polar caps. A vital part of the program to model such objects is to determine the column density of material in the pulsar atmosphere traversed by the accreting material before is comes to a halt. Such stopping depths are calculated. The accreting material and the X-ray pulsar atmospheres were idealized as fully ionized plasmas consisting only of electrons and protons. A high magnetic field permeates the atmospheric plasma, and causes the motion of atmospheric electrons perpendicular to the field to be quantized into discrete Landau levels. All atmospheric electrons initially lie in the Landau ground state, but in these calculations of Coulomb collisions between atmospheric electrons and accreting protons, processes are allowed which leave the electrons in the first excited Landau level. The inclusion of such processes in the model should be of great use in calculating cyclotron line emission from X-ray pulsars. Interactions between accreting protons and the collective modes of the atmospheric plasma are considered. Dissert. Abstr.

N88-11708 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
IRRADIATIONS. ACCUMULATED DOSES. HEAVY IONS
Jacques Bourrieau *In* CNES, Space Environment Technology Apr. 1987 p 125-194 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
Copyright Avail: CEPADUES-Editions, Toulouse, France

N88-11714 Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.
HEAVY ELEMENT COMPOSITIONS AND ENERGY SPECTRA OF GALACTIC AND SOLAR COSMIC RAYS
J. J. Engelmann *In* CNES, Space Environment Technology Apr. 1987 p 331-351 In FRENCH; ENGLISH summary (For primary document see N88-11702 03-18)
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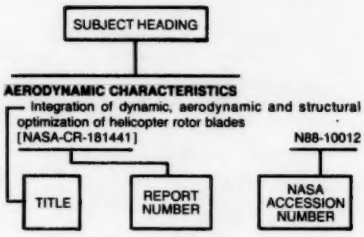
99 GENERAL

No abstracts in this category.

Typical Subject Index Listing



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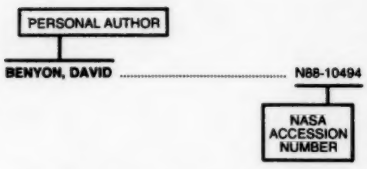

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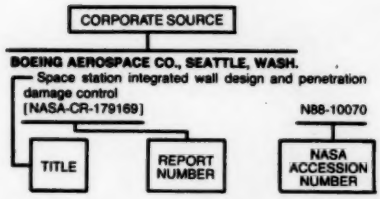

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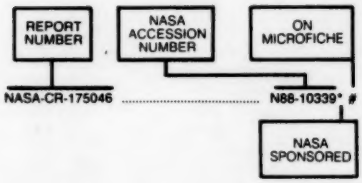

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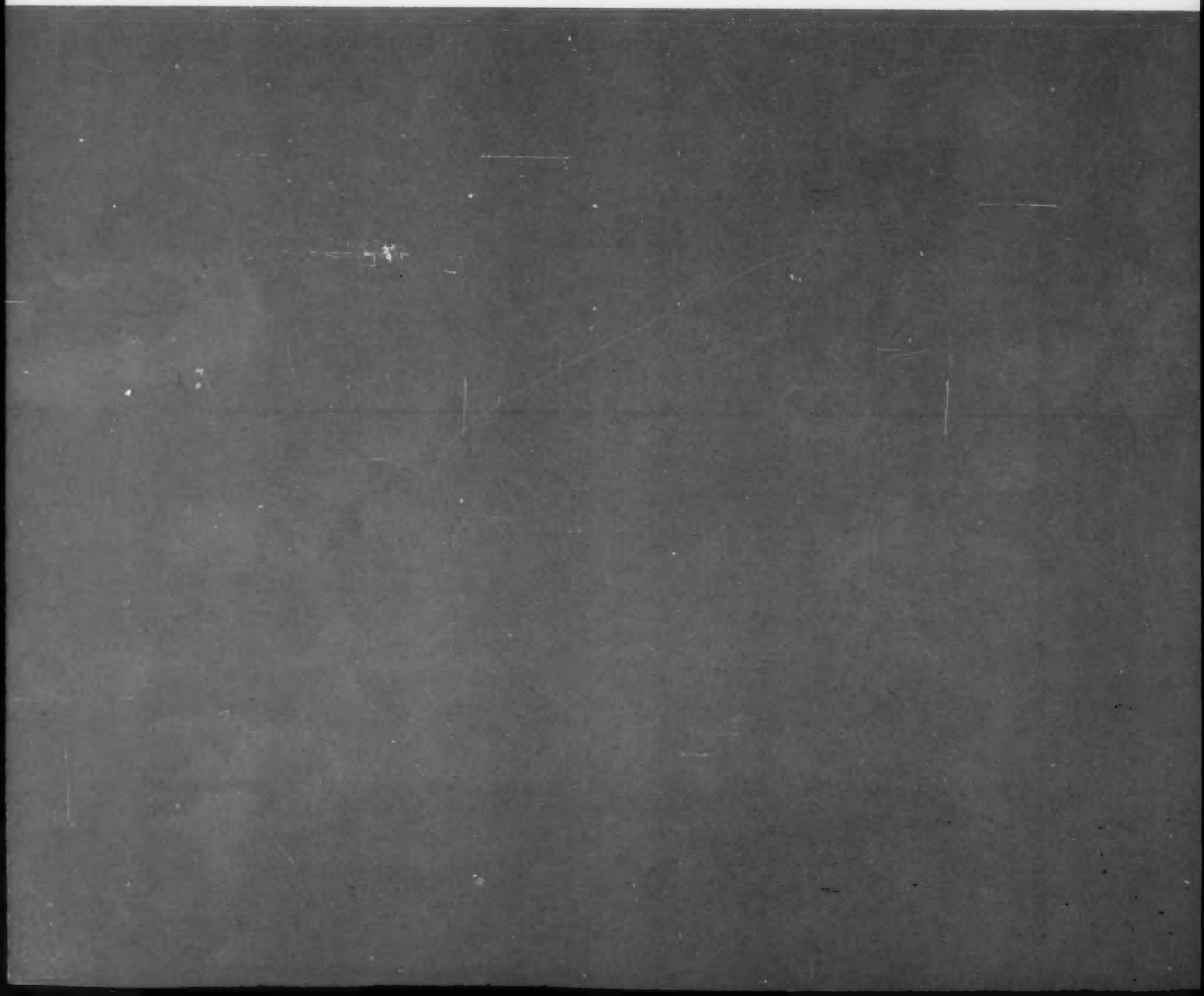
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